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NOTICE.

It has been found desirable to present the information contained in this issue of the Bulletin in different sections so that the subject matter in which the reader is interested may be more accessible. It is hoped also by this arrangement to create a greater interest in each division and thereby to induce planters to become contributors in those sections to which they have given special attention, and about which they have probably accumulated a large amount of useful information.

In the last issue original contributions, signed by the authors, appeared and the signatures add considerably to the value of such contributions. Others appear in this issue, and it is hoped that the number of this useful class of contributors will increase.

The addition of another class is also invited. These can render valuable assistance in the work of editing by abstracting from other publications anything that may appear to be deserving of reproduction in the Agricultural Bulletin. In every case the source should form part of the communication. All contributions should be addressed "Department of Agriculture."

In the present issue a good deal of attention has been paid to Statistics—a very useful branch of agricultural information which has hitherto received but little attention.

The Bulletin will be issued in future under its present more appropriate title.

P. CARMODY,
Director.

THE BOARD OF AGRICULTURE.

The Board by its members appointed by the Governor represents the principal industries of the Colony. It has control of its own funds which are raised from the exports of Cacao, Sugar and Coconuts. These funds will be chiefly employed for the purpose of providing a Staff of Experts to investigate any diseases that require special attention, and which an individual Planter would be unable to undertake either on account of the expense, or the want of expert knowledge. The present Expert Staff will consist of an Entomologist, a Mycologist, and Agricultural Inspectors. In addition to reporting on specimens sent to the Central Office, they will make personal visits to estates or districts whenever it is advisable to do so, and during these visits Planters will be shown the best methods of preparing and applying fungicides and insecticides, and of treating diseases generally. The principal work of the Inspectors will be to report the presence of diseases, and to instruct Planters in the Practical methods of Sanitation and cultivation. The Inspectors appointed are required to possess considerable experience in cacao cultivation and they have been selected from the most suitable candidates.

THE DEPARTMENT OF AGRICULTURE.

The Department has for some months past been undergoing the necessary preliminary processes of organisation. The several Departments of the service connected with agriculture are now linked together, and co-operating with each other, and with the Officers of the Board of Agriculture will be able to deal comprehensively with every problem likely to arise.

The Department remains a purely official body, advised by the Board of Agriculture on important matters.

While efforts will be made to give Planters every assistance in Agriculture in all its branches; it is obvious that the success of the Department must largely depend on the co-operation of the Planters. A small expert staff will be sufficient at present to deal with Agricultural problems if the planters will provide the materials requiring examination and which come to their notice in the discharge of their daily duties. Planters are therefore invited to forward specimens of plants diseased, or supposed to be diseased, of insects or birds causing injury to crops, and of any substances which, in their opinion, are deserving of investigation. These specimens will be conveyed free by post *if* addressed to "The Director, Department of Agriculture," but not otherwise. Specimens should not be addressed to any individual by name, as this course often results in delay. All specimens should be accompanied by a short statement of the observations made by the sender as to the nature and extent of the injury caused.

At the Central Office there will be permanently exhibited specimens of the local plant diseases at present known, and of insects injurious to cultivation. Planters of all grades are invited to inspect these, and make themselves acquainted with their appearance, so that they may be able to recognise them should they be present on their estates. The remedial and preventive methods of treatment will also be explained. In the present issue of the Bulletin a brief summary has been given of the diseases of Cacao and Sugar.

At this office there will also be established a Reference Library of Books and Periodicals which may be consulted. Arrangements will subsequently be made for lending books to Planters.

All applications for information will receive early and careful attention.

BULLETIN OF AGRICULTURAL INFORMATION.

1. The Office, Herbarium and Nurseries at St. Clair, are open to the public on week days from 8 a.m. to 4 p.m., excepting Saturdays when the office is closed at 1 p.m.

2. Planters and all interested in Agriculture, Horticulture and Botany are invited to make full use of the Department.

3. Advice may at all times be obtained by correspondence.

4. Wednesdays and Fridays are especially reserved for interviews with Planters and others seeking information on Agricultural matters.

5. The services of trained Gardeners able to graft, bud, pot, etc., may be obtained on application at prices varying from 30 cents to 50 cents a day and travelling expenses.

6. To avoid delay, all letters should be addressed to: The Superintendent, Experiment Station, St. Clair, Port-of-Spain.

Section I.—SUGAR.

31.—Exports of Sugar and Sugar Products since 1900.

Year.	Sugar.	Molasses.	Rum.	Bitters.
	Tons.	Gallons.	Gallons.	Gallons.
1900	40,619	777,000	57,600	37,000
1901–2	45,254	482,000	178,000	32,000
1902–3	47,259	301,000	213,000	39,000
1903–4	40,384	328,000	127,000	28,000
1904–5	47,578	508,000	85,000	30,000
1905–6	36,241	273,000	744	33,000
1906–7	45,004	426,000	219,000	35,000
1907–8	46,270	525,000	185,000	35,000

32.—Where our sugar goes.

Period.	Great Britain.	U. S. A.	Other Colonies.
	Tons.	Tons.	Tons.
1881–5—annual average..	25,550	28,130	1,912
1886–90 ,, ...	17,555	36,450	319
1891–95 ,, ...	21,471	26,373	429
1896–1900 ,, ...	23,990	24,090	1,274
1901–2–1905–6 ,, ..	24,443	10,852	8,047 (Canada chiefly.)
1906–7	23,945	143	20,995 ,,
1907–8	23,721	121	22,349 ,,

The foregoing figures show that the exports of sugar to Great Britain are nearly constant, and that while the exports to the United States have decreased considerably, the exports to Canada have increased considerably. The exports to Canada now equal those to Great Britain.

33.—Seedling Canes.

About 1,200 seedling canes have been received from British Guiana and have been planted in the best part of the St. Clair Station.

The following are the numbers of the varieties D, 116, 145, 366, 625, 2468, 3956, 4397, 4805

When tested here, the best of these varieties will be distributed among the estates.

The following average yields of saccharose in tons per acre per annum from 1902–1907 (6 crops) have been obtained for some of the above canes:—

No. 116	3·74 tons.
„ 145	4·48 „
„ 625	4·75 „
„ 3956	3·80 „

D 625 is grown in British Guiana to the extent of 4,500 acres.

34.—Waste products of Sugar-Cane.

A great deal of attention has recently been paid to the hitherto waste products of the Sugar-cane. The conversion of megass into paper by Mr. Bert de Lamarre at Orange Grove factory has attracted serious notice in every country interested in Cane-growing, and inquiries have been received from Cuba, India, Jamaica and other places for particulars and specimens. The paper mill is now turning out ten tons of commercial paper daily, and is capable of a much greater output.

Wax, another waste product, was referred to in the last issue of the Bulletin. An application for a local patent has been filed, and the following paragraphs have been selected to show the nature of the process used, and the claims made, by the inventor. It appears probable from this new era of activity that science may render so much assistance to Cane growers, that competition with Beet sugar will be less feared in the future:—

Extracts from Mr. Abraham Wynberg's Patent. Paragraphs 36-40.

The manufacture and production of wax, or fatty substances, from sugar-cane, or filter press-cake, or other residues of sugar-cane, whether the wax or fatty substances be refined and bleached, or not, and with, or without, the recovery of otherwise waste sugar, substantially as hereinbefore described.

The obtainment of wax, or fatty substances (and also, if required, of sugar) contained in the filter press-cake, or other residues of the cane-sugar industry by grinding, drying and dissolving in a solvent, such as ether, alcohol, carbon-disulphide, tetra-chlormethane, benzine, or other suitable hydrocarbon.

The refining and bleaching of wax and fatty substances, obtained according to either the preceding claiming clauses by treating the wax, or fatty substances, with nascent chlorine, or a bleaching earth, or both.

In connection with the process in accordance with the preceding claiming clauses, the decompositions and separation of the wax, or fatty substances, into a soft, saponifiable, body of light colour and into a hard and unsaponifiable body of darker colour, substantially as hereinbefore described.

As new articles of manufacture, the waxes, or fatty substances, obtained as hereinbefore set forth and claimed.

35.—Cane Farming.

Steady progress is maintained in this branch of the Sugar industry. There were last year 11,541 cane farmers, the East Indians being in a majority of 300. The minimum price has been raised to 9/- a ton. This and the liberal prizes offered to cane-farmers by local proprietors at the annual Agricultural Shows, should place cane-farming on a more permanent and profitable basis. The various judges have reported very highly of the work done by farmers who have been awarded prizes; and those farmers who have been awarded the additional prizes in each district have every reason to be proud of their position of superiority. Men of this stamp are

Section I.—SUGAR.—*Continued.*

the back-bone of an agricultural community, and those planters who originated this method of recognising their merits are deserving of very great praise.

The Wardens returns show that 18,576 acres are cultivated by cane-farmers, as compared with 47,070 acres of Estate canes. There appears to be therefore nearly one-third of the total acreage in the hands of cane-farmers; but there are reasonable prospects of this proportion being increased in the near future, and with advantage to the sugar industry.

The cane-farmer has many lessons yet to learn in the art of cultivation, and it is sincerely to be hoped that awards of prizes will not lead him to believe that he has nothing more to learn.

It is very desirable that he should give his attention to the advantages which some varieties of seedling canes offer. And a study of the profits to be derived from the judicious use of mineral manures would well repay the labour which it involves. Pen manure has advantages, but it also has many disadvantages which are not known to the cane-farmer. The Department of Agriculture will at all times be willing to render advice and assistance on these points.

Section II.—CACAO.

36.—Exports of Cacao since 1900.

Year.	Quantity.	Year.	Quantity.
1900... ...	30,383,000 lbs.	1904-5 ..	40,753,000 lbs.
1901-2 ...	30,154,000 ,,	1905-6 ..	48,416,000 ,,
1902-3 ..	37,585,000 ,,	1906-7 ..	27,570,000 ,,
1903-4 ...	36,154,000 ,,	1907-8 ..	49,730,000 ,,

37.—Where our Cacao goes.

Period.	Great Britain.	U. S. A.	France.	Other Colonies.
	lbs.	lbs.	lbs.	lbs.
1881-5 Annual average	7,300,000	1,500,000	3,060,000	60,000
1886-90 ,, ...	8,500,000	3,400,000	5,700,000	220,000
1891-95 ,, ...	7,400,000	5,200,000	9,000,000	520,000
1896-1900 ,, ...	9,200,000	6,700,000	9,200,000	1,000,000
1901-2—1905-6 ,, ...	8,300,000	14,500,000	14,100,000	1,700,000
1906-7 ,, ...	3,700,000	15,100,000	7,700,000	90,000
1907-8 ,, ...	7,400,000	16,700,000	24,200,000	50,000

While the Exports to Great Britain are fairly constant, the Exports to the United States and France are increasing rapidly.

Section II.—CACAO.—*Continued.*

38.—Shade.

(*Robinson Crusoe.*)

All trees in their infancy, not excepting the wind-loving coconut palm, seem to prefer overhead shade. In all the recent discussions on shade, this fact is admitted by all, but there is still a difference of opinion as to the advisability of shade for old cocoa trees.

If a planter said: "There has been so much diverse opinion expressed "on the question of shade, I am at a loss to know whether to retain or cut "out my shade, what would you advise?" Our reply would be—How do you prune your cocoa—for on that depends the answer to the question of shade or no shade. If you prune your trees heavily, as is the general custom in Trinidad, cutting off all shoots, some secondary branches from each of the three primaries, then you require some overhead shade for the cocoa tree so pruned has not sufficient foliage to protect the tender flower. On the other hand if you prune your cocoa tree very lightly, leaving a shoot from the fork, and one, or even two from the ground, and taking very little from the centre of your tree, then you require no overhead shade, for the tree has abundant foliage to protect itself.

But the cocoa, if not in a naturally sheltered valley, requires protection against wind, and each planter who goes in for the light pruning system, must judge of the requirements of his trees according to the position of his cocoa field. In the open plains of Trinidad for instance, wind-breaks will require to be denser and at closer intervals, than in places less exposed to strong winds. That overhead shade, preventing as it does, the entrance of sunlight and air, deprives the cocoa tree of crop there is no manner of doubt, as has been proved by the many and ample experiments which have been made in recent years.

At the beginning of June last, a cocoa field of 2½ acres, planted in 1902 and shaded with Saman was deprived of its overhead shade, the Samans being lopped down to the fork. One row of Samans was left as a wind-break for the next 2½-acre lot which was shaded with the Bocare Immortel, and the Bocare was entirely cut down on the "sudden death" principle. The cocoa trees on these two small fields have been making new wood ever since shade was cut out, and are now—January—full of crop in all stages, far exceeding the previous year, but the interesting part of this experiment is that the cocoa trees under the Samans left as a wind-break, have nothing like the amount of crop compared with those in the open, and yet these are the largest cocoa trees in the field. Now what is the best way to get rid of shade, "sudden death" as illustrated above, is very expensive especially in the case of Immortels with spines, each branch is lopped off, beginning at the top of the tree downwards to the fork, and then the main stem is felled, some are of opinion that this method of getting rid of shade is too much of a sudden shock to the cocoa tree; in the case above described no injury has resulted and if the cutting out be done at the beginning of the wet season we think it can be done with safety. The other method is "lingering death" that is ring barking the shade tree, and is certainly much less costly to begin with, but we have had such smashing of the cocoa from the falling trees, especially the Bocare Immortel, that we are inclined to look upon "sudden death" as the less costly in the long run. The Bocare rots more quickly downwards from the point of ring barking, than it does above, hence when it falls the upper portion is comparatively green and heavy, and crushes everything down before it. The mountain Immortel on the other hand, decays branch by branch from the top downwards and gives very little trouble. We have recently ring barked the Bocare above the fork, or at least ten feet up, tarring, or painting the barked portion with strong solution of sulphate of copper to prevent borers getting in, and we hope by this method, the tree will die first from above the ring, we observe that several trees so

treated are sending out shoots below the ring, which points to the success of the experiment.

We are planting in our young cultivation several different kinds of spineless shade trees, intending to lop them back at the age of say six years, as a mulch for the cocoa, at six years our cocoa trees as a rule meet each other, and have sufficient foliage to protect themselves. Some of the shade trees we are trying are Albizzia Moluccana. A. Lebbek, named *women's tongues* in Barbados, it is said to be able to resist the strongest winds, the seed pods make a rattling noise in the breeze, hence the name.. Flamboyant, Cassia marginata, the spineless Immortel or Dadap Glyricidia, the two latter grow very readily from cuttings, perhaps the best of the lot for mulching purposes is the Dadap. As to the spine Immortels never again!

We have a considerable area of cocoa interplanted with the Castilloa rubber as a shade, this cultivation is about nine years old. If we had to do our planting over again, we would keep the rubber and cocoa in separate fields, not because the cocoa has not grown as well under the rubber, as under the immortel for we can see no difference but the shade is too much at 24 feet x 48 feet and to plant the rubber at 60 feet x 60 feet—the nearest we consider admissible to allow the cocoa to bear as it should—means too long a distance for the tapper to travel to collect the latex.

39.—Pruning.

Should a Cacao tree have more than one main trunk?

W. E. Broadway.

This brief note refers only to trees in full-bearing. Views of men, will change, I imagine, as we learn more of the methods followed by intelligent and successful planters. Two extremes have come under my observation within the past twenty years; the precise way of retaining one trunk, or stem, allowing of no sucker (chupon or gormandizer), to remain, and (2) the retention of every chupon to establish itself, at its own sweet will, gradually resulting in one complete mass of stems and foliage hiding, or partly screening, the original trunk in their centre. Between these two limits there are the "come-betweens," planters who permit from one to three *renews* (suckers) which have sprung from the base of the mother stem and which will, in time, develop roots to penetrate down into the soil and so become, more or less, independent of the original plant. Which of these systems then is the best? I am prepared to say that, like the shade question, this is unanswerable. What answers beneficially in one place may not be satisfactory in another. Given healthy, well-balanced trees, I would prefer to stick to that system where but one trunk is allowed to stand with no sucker encumbrances about it. If, on the other hand, trees were poorly shaped, I would favour the custom of those who allow two to three re-news to stay with the view that, in time, they would assist the parent in supplementing the crop, and perhaps of replacing it altogether at a later time. If again the tree had become in a poor state of health through some cause or the other, I would allow more suckers to grow selecting finally the two or three strongest of them. This would end in the establishment of two to three main stems or trunks to the "hole," instead of one only. . . . .

In the liberal application of animal manures, the burial of quantities of green "bush," plenty of daylight above and proper drainage lie the secret of success. The bearing surfaces of a cacao tree call out for *air*, and without a sufficient freedom in this respect no one, I take it, can seriously expect, a bumper crop of healthy, fully developed pods. Clean cuts, and the painting over of them while fresh, are desirable details requiring close attention. Many a tree has been ruined through excessive pruning, and great numbers deformed through the ignorance of the operator in the earlier stages of a tree's career.

Section II.—CACAO.—*Continued.*

40.—Immortelle Trees.

Nitrogen content of nodules and rootlets.

At the request of Mr. J. G. de Gannes, who has sent in a supply of roots with nodules, analyses have been made for the purpose of determining the Nitrogen content of the nodules.

It appeared desirable at the same time to compare the Nitrogen content of the nodules with that of the remaining part of the roots, and the results obtained are interesting.

The following are the analytical results on the dry material:—

	Ash.		Ash. Alkalinity of. (K_2O)		Total Nitrogen.
		Anauco.			
Rootlets ...	12·51	...	0·38	...	2·49
Nodules ...	12·56	...	0·22	...	4·09
		Bucare.			
Rootlets ...	13·15	...	0·096	...	2·49
Nodules ...	13·35	...	0·108	...	4·09

In both cases the amount of Nitrogen in the nodules was considerably greater than in the rootlets. The higher percentage of alkalinity in the ash of the Anauco variety is remarkable, and the analysis will be repeated when opportunity offers.

It was suggested that the roots should be tested when the trees were flowering, and Mr. de Gannes kindly supplied fresh material. The following results were obtained:—

		Percentage of Nitrogen in Rootlets.		Percentage of Nitrogen in Nodules.
Anauco (flowering)	...	2·63	...	3·86
Bucare ,,	...	2·78	...	4·48

In both kinds the Nitrogen content of the rootlets has increased slightly; in the Anauco there is somewhat less Nitrogen in the nodules when the trees are flowering—the reverse being the case with the Bucare nodules. The difference is not very great however; but the subject is deserving of further investigation.

It was observed in the samples received that the number of nodules on the Anauco roots were few in comparison with the number of nodules on the Bucare roots. This was particularly noticeable in the samples taken during the period of flowering.

Section III.—COCONUTS.

41.—Exports of Coconuts and Coconut products since 1900.

Year.	Coconuts.	Copra.	Coconut Oil.	Coconut Meal.
	No.		Gallons.	
1900	9,565,000	£3,378	12,584	£ 63
1901–2	10,242,000	927,000 lbs.	15,944	£ 4
1902–3	10,397,000	1,325,000 ,,	25,885	£ 116
1903–4	9,985,000	2,470,000 ,,	36,715	285 lbs.
1904–5	10,554,000	1,933,000 ,,	21,038	113,260 ,,
1905–6	11,037,000	2,007,000 ,,	26,395	180,086 ,,
1906–7	13,089,000	3,062,000 ,,	16,863	42,583 ,,
1907–8	14,867,000	2,319,000 ,,	12,342	56,633 ,,

42.—Where our Coconuts go.

Year.	U.S.A.	United Kingdom.	British North America.	Holland.	France.	Germany.	British West Indies.	Other British Colonies.	French West Indies.	Spain.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
1900	2,327,085	6,261,091	300,050	2,500	...	482,058	191,034	...	2,000	...
1901–2	2,689,863	6,820,798	251,510	...	...	252,246	175,890	...	...	52,400
1902–3	3,951,801	5,986,605	88,947	114,900	...	80,145	174,730	...	...	...
1903–4	4,245,530	5,251,375	107,922	134,200	...	89,080	135,100	...	2,000	20,000
1904–5	8,508,226	1,033,150	581,267	69,950	52,800	104,350	200,756	4,070	...	...
1905–6	9,054,000	906,000	659,000	160,000	...	57,000	197,000	...	...	...
1906–7	11,490,000	1,012,000	314,000	72,000	...	33,000	165,000	...	...	...
1907–8	13,815,000	485,000	322,000	1,000	166,000	20,000	56,000	...	...	...

The increased Exports to the United States are as remarkable as the decreased Exports to the United Kingdom.

Section III.—COCONUTS.—*Continued.*

43.—Where our Copra goes.

Year.	United Kingdom.	France.	U. S. A.	Germany.	Holland.	Spain.
1900... ...	£1,756	...	£143	£1,474	£5	...
1901-2 ...	653,459 lbs	2,533 lbs.	93,432 lbs.	33,331 lbs	144,261 lbs	...
1902-3 ...	1,037,485 ,,	40,280 ,,	...	122,267 ,,	125,199 ,,	...
1903-4 ...	1,313,201 ,,	198,647 ,,	35,336 ,,	192,265 ,,	614,410 ,,	7,944 lbs.
1904-5 ...	1,340,357 ,,	348,978 ,,	8,920 ,,	89,954 ,,	144,838 ,,	...
1905-6 ...	1,520,000 ,,	328,000 ,,	...	30,000 ,,	127,000 ,,	..
1906-7 ...	2,586,000 ,,	475,000 ,,	...	...	...	...
1907-8 ...	1,930,000 ,,	381,000 ,,	140 lbs.	...	...	...

44.—Coconut.

Notes on the sprouting, and on Copra and Coconut Oil.

No evidence could be obtained of the existence of a fat-hydrolysing enzyme in the "meat," milk, and "foot" of the coconut. During the sprouting of the coconut, oil is lost by the "meat"; it is not taken up as such by any other portion of the nut, but is either consumed to furnish energy for the growing plant or is transformed by progressive synthesis into sugar and, finally, into cellulose. Sugar is lost by the "meat" and milk, but a corresponding quantity is gained by the "foot." Six different moulds, capable of hydrolysing and destroying fat, have been isolated from among the many organisms growing on rancid copra and coconut "meat"; this fat destruction is independent of bacterial action. Copra which had been acted on by moulds was found to have lost almost all its sugar, whilst the only effect of bacteria was the production of a more or less disagreeable sour odour and the disintegration of the "meat."

The deterioration of freshly prepared coconut oil is produced by at least three entirely independent processes and may be divided into two distinct periods of time. The first, rapid decomposition of the fat is caused by moulds which are either pressed out with the oil, together with sufficient sugars and proteins for their growth, or, in the case of hot-pressed oils, enter the oil from the air. The action continues as long as there is sufficient nutritive material for mould growth in the oil; it may be completely checked by filtration, preferably after heating to a temperature of 100°C. Towards the end of this first period, oxidation by the air sets in; in extreme cases, the oxidation may cause extremely rapid deterioration, but can be entirely prevented by storing the oil in completely filled air-tight vessels. In addition to the two above-mentioned processes, slight hydrolysis due to heat, moisture and free acids already present is constantly taking place, and there is reason to believe that some hydrolysis is brought about by enzymes produced by the moulds. Light has no apparent effect on the oxidation by air of coconut oil.—(*Philippine Journal of Science.*)

Section IV.—OTHER FRUITS.

45.—Exports of Bananas and Oranges.

Year.	United Kingdom.	U. S. A.	France.	Total Bunches and Crates.	Total Oranges.
	Bunches.	Bunches.	Bunches.		Packages.
1906-7	15,600	432	...	16,000	2,256
1907-8	52,600	2,360	700	56,000	2,991
1908-9	...	...	...	91,042	Not ascertained.

Section IV.—OTHER FRUITS.—*Continued.*

The increase in the exports of bananas is very satisfactory; and will come as a welcome surprise to many. It works out at an average of 3,600 bunches every fortnight, and should be encouraging to those who have had to overcome exceptional difficulties in their attempts to establish a market for this promising local industry. The trade is yet in its infancy; but the average prices realised are sufficient to warrant the recommendation that Bananas might be more extensively grown, especially as a shade for Cacao in its early stages. Mr. Adie's report which appears on this page is well worth consideration by prospective cacao planters.

Once a fruit trade in Bananas is established, other fruits will be exported. Oranges and limes grow in profusion, and their quality is excellent; avocado pears and grafted mangoes must for some time to come command fancy prices; and, with the cold storage necessary for Bananas, the other fruits could be carried at no great additional cost. The Banana trade, as a nucleus of a larger fruit trade in the future, deserves every encouragement and assistance.

46.—The Banana as a profitable Auxiliary Crop.

Dear Sir,

I am in receipt of yours of the 25th ultimo (No. 151), asking for some particulars regarding the cultivating of Gros Michel Banana as a temporary shade for cocoa, in view of growing them for export and as a financial auxiliary in establishing a cocoa plantation, and I have pleasure in giving you any information that may be of use to anyone desirous of working on the same lines as Mr. Meyer and I have done.

Three years ago, having 200 acres of land to put in cocoa we were impressed with the idea of planting some variety of Banana that would be of commercial value, and at the same time giving the necessary shade required for cocoa, and decided to plant the Gros Michel in place of the Sucre fig (a fig very adaptable as shade, but of practically no market value) with the view of export to the English market. After careful consideration of the scarcity and expensiveness of day labour in districts newly opened up, we decided to plant by the contract system, we supplying the plants and the contractors doing the planting, cultivating, and reaping the same, the remaining expenditure for transport, etc., being equally divided between both parties, and the nett profits divided.

In the first instance the plants were acquired from the following Estates and at the following rates, and were from Jamaica stock :—

River Estate	...	at \$20 00 per thousand.
Craignish	...	at \$25 00 ,, ,,
St. Augustine	...	at \$24 00 ,, ,,

The transport of these plants cost practically \$10 00 per thousand, making the actual cost of plants landed on the estate, approximately, \$33 00 per thousand.

The bananas were planted the same distance apart as the cocoa—12 ft. x 12 ft. and figures out at 302 plants to the acre as against the planting of Sucre figs—12 ft. x 6 ft. apart = 605 plants to the acre.

The usual cost of the Sucre figs is \$6 00 per thousand, so the difference of the initial cost per acre of both varieties would be as follows :—

Gros Michel Bananas	—302 plants per acre	—\$33 00 per 1,000	—\$9 66
Sucre Figs ...	—605 ,, ,,	—\$ 6 00 ,, ,,	—\$3 63
Difference in favour of Sucre Figs ...			\$6 03

Section IV.—OTHER FRUITS.—*Continued.*

The following is a copy of the account sales of Bananas exported to England from January to 15th December, 1908, and represents nett profit per bunch at Port-of-Spain. The cost of transport from Estate to Port-of-Spain has still to be deducted :—

January	... 1,061	bunches—netted per bunch	...	31 cents.
February	... 747	,, ,, ,, ,,	...	31 ,,
March	... 617	,, ,, ,, ,,	...	31 ,,
April	... 750	,, ,, ,, ,,	...	25 ,,
May	... 401	,, ,, ,, ,,	...	25 ,,
June	... 572	,, ,, ,, ,,	...	43 ,,
July	... 802	,, ,, ,, ,,	...	41 ,,
August	... 935	,, ,, ,, ,,	...	51 ,,
September	... 890	,, ,, ,, ,,	...	52 ,,
October	... 1,879	,, ,, ,, ,,	...	37 ,,
November 15th	... 2,140	,, ,, ,, ,,	...	37 ,,
	10,794	,, average per bunch	...	36 ,,

This works out at an average price of about 36 cents per bunch

Owing to the distance from the Estate to San Fernando (12 miles) the cost of transport is very heavy, and costs approximately to put on board Ship 12 cts. per bunch. This leaves a net profit to be divided between owner and contractor of 24 cts. per bunch.

There is practically no sale for the enormous quantity of Sucre Figs that could be put on the local market, consequently large quantities are left to rot on the ground, and in many districts only from 1 to 2 cents per bunch can be realized on the spot.

The time between planting and reaping of both varieties is practically the same (12 months) and the following comparative Estimate of profits per acre may be of interest to you :—

Gros Michel Banana—302 bunches per acre at 24 cts.	=	$72 48
Sucre ,, 605 ,, ,, ,, at 2 cts.	=	12 10
		$60 38
Less difference in original cost of Plants	...	$ 6 03
Difference in favour of Gros Michel per acre	...	$54 35

In conclusion I may state that the results alluded to in the account sales were not attained under favourable conditions as a market had to be established and this took both time and trouble, but I am of opinion that the future prospects are better than when we commenced and any one desirous of establishing a Cocoa Plantation may find it worth his time to take the growing of the Gros Michel Banana as a temporary shade into serious consideration.

J. Adie.

Belle Vue Estate,
12th February, 1909.

47.—Citrus Budding.

Botanic Station, Tobago.

W. E. Broadway.

The stocks are raised in the usual manner from seeds of the common sour orange. These are sown at first in beds, and when two or three inches high are taken up and transplanted into straight rows, 12 inches apart, and six inches from plant to plant. When a foot high, which will be when they are some six or nine months old, they are fit to be, what is known in budding parlance, *worked*, *i.e.*, in a suitable condition to attach the bud to. The well-known cut ⊥ (an inverted shaped letter T) we

Section IV.—OTHER FRUITS.—*Continued.*

adopt is made near the ground into the supple bark, the bud inserted, and then the cut portion, with the bud in position, wrapped around with waxed tape taking care not to bind too firmly over the bud for fear of damaging it. The upper portion of the stock is, *at the same time*, cut off close to where the bud has been fixed.

Eight days after the operation each ligature is unwrapped when it is found that 10 to 11 have taken out of every dozen worked. It is immaterial whether the stocks are partially or fully exposed to the sun. Budding done at this early stage allows lifting and potting far easier than if the stocks had become older and larger with a deeper lot of roots anchoring them to the ground. For the sake of encouragement we pay our boys one cent (halfpenny) each after the plants become established in bamboo pots. The results justify the small expenditure.

Section V.—GENERAL FORESTRY.

48.—Mahogany Seeds.

A large consignment of seeds from British Honduras is expected in April or May.

They will be sold at cost price, $1 per 1,000.

If the whole consignment is not taken up by planters, some will be planted at St. Clair, and the plants will be ready for sale from September, 1909, to December, 1910. The price of plants will be $5 per 100.

This is a favourable opportunity for planting up this valuable timber tree in spare lands.

Section VI.—RUBBER.

49.—The Rubber plants of the Ivory Coast.

The chief rubber-yielding plant of the Ivory Coast is *Funtumia elastica*. The methods of obtaining and subsequently working up the latex from this tree are such as to leave much room for improvement; the addition of other latices to the *Funtumia* latex is one of the practices to be dealt with, inasmuch as rubber prepared from such mixtures is considerably diminished in value. *Ficus vogelii* occurs as an epiphytic form in the region of the sea coast, and the rubber obtained from it, wrongly called "liana rubber" is shipped from Bliéron, Tabou, and Béréby. Coagulation is effected by allowing the latex to stand; the rubber is of only medium quality, slightly tacky on the surface, and possessed of little elasticity and "nerve." Four or five species of *Landolphia* also occur including L. owariensis, which yields the best product. The latex is either allowed to coagulate spontaneously, or the coagulation is brought about by the addition of citric acid, salt water, etc. *Clitandra elastica* is also a valuable rubber vine. The latex from this is coagulated by prolonged heating, the clot obtained being afterwards kneaded with the hands. The rubber, which is at first almost white, and possessed of little elasticity, gradually darkens and becomes more elastic. *Clitandra eugenifolia* and *laurifolia* are two new species which yield good rubber, though, partly on account of the smallness of their stems, only in very small quantity. *Periploca nigrescens* the richest stems of which contain only 0·5 per cent. of caoutchouc, is of frequent occurrence. Of the large number of other plants which contain a latex, the only one to which attention is drawn is the large liana, *Carpodinus hirsuta*, from which "Accra paste" is obtained; this product is unfortunately often used to adulterate *Kickxia* rubber ("lumps.") — A Chevalier, L'Agriculture pratique des pays chauds., Gummi-Zeit.

Section VI.—RUBBER.—*Continued.*

50.—Rubber Latex:

Treatment to prevent darkening of the Rubber.

The discoloration of (plantation) rubber, which is due to the action of an oxidising enzyme upon soluble organic substances allied to tannin, may be prevented by destroying the enzyme present in the latex, or in the rubber prepared from it, by the action of heat. The heat may be applied either (1) by passing steam into the latex until a temperature of 80°C. is reached and maintaining the temperature at this level for 15 minutes or so; (2) by immersing the "biscuits" or sheets in water at 80°C; or (3) by using hot water, or steam heated rollers for washing the rubber. The first of these methods closely resembles in principle that employed in the production of "hard Para."—(K. M. Bamber, Bulletin *L'Agric. des Straits*—Caout. and Gutta-percha).

51.—The Tapping of Cultivated Castilloa.

(Abstract by R. H. Lock.)

(*Journal d' Agriculture Tropicale*, May, 1908, p. 142.)

Whilst the area under Hevea has been rapidly increasing in Indo-Malaya, Castilloa has been taking an important place in the plantation of Mexico and Central America, and it has also been tried in several of the West Indian Islands. In German West Africa, New Guinea and Samoa this cultivation has been less successful.

The structure of the laticiferous tubes of Castilloa, renders necessary a different method of tapping from that employed in the case of Hevea, the former being tapped much less frequently in order to obtain the best results.

Three tapping knives, specially designed for use with Castilloa, are described in the present article, and two of them are figured. A feature common to all three is the U-shaped blade, differing in the three cases in radius of the curve and angle of attachment to the handle.

The knives are the inventions of Dr. Strunk, Dr. Preuss and Mr. V. Smith, a planter of Soconusco, respectively.

With regard to systems of tapping it is admitted that the ideal method has not yet been evolved. In Mexico the system adopted is to make 3 or 4 V cuts on each tree. The limbs of the V do not quite meet at the base, but a space of two or three inches of bark is left intact and two partial spirals are traced upon the bark. The first V is made as near the base of the trunk as possible, and others at successive distances of two feet above it. The trees are first tapped when they have arrived at an age of six or seven years and a circumference of 2 feet a yard from the ground.

Various other methods, differing slightly from the above are enumerated, as well as several different modes of collecting the latex; also estimates of the yield, which are admittedly somewhat vague.

52.—Notes on Funtumia elastica.

By Frederick de Valda.

West African rubbers have not at the present time a very favourable reputation in the European markets. In the endeavour to obtain rubber for sale, the juices of many different trees, some of them quite innocent of any caoutchouc, are mixed with good latices of Funtumia, Landolphia, etc. Putrefaction of the proteid constituents soon sets in, and the delectable preparations known to the trade as Gold Coast paste, lump, soft ball, etc., are the evil-smelling results. These different rubbers are valued at from 10d. to 1s. 9d. per lb., and require a man with a very strong stomach

Section VI.—RUBBER.—*Continued.*

indeed to handle them. Some exceptions, it is true, have a very favourable reputation; fine nigger-ball, for instance, has obtained as much as 3s. to 3s. 6d. per lb.; but if we search for the reason of the higher price these latter rubbers have obtained, we invariably find that they consist either of unadulterated Funtumia, Landolphia, or one or two other fine rubbers.

While Para rubber has always reached the European markets more or less unadulterated, and has thus an excellent reputation behind it, *Funtumia elastica* has very rarely been shipped to Europe in its pure state. When this has been done, a price equal to hard Para has always been obtained. The bad quality of West African rubbers will always continue as long as the collection and preparation of the rubber are carried out in the native fashion. These natives have not the same intelligence that the Central and South American collectors have. The local merchants and traders are to blame for not encouraging the production of high-grade rubbers by paying a corresponding price for them.*

The only way to establish *F. elastica* in the eye of the manufacturer is to cultivate it on the same basis, and with the same thoroughness, that *Hevea brasiliensis* has been taken up and cultivated in the East. The planter will then find that he has fewer difficulties to contend with in establishing his plantation, and simpler methods will suffice to produce the cured article from the milk of the trees.

It is impossible, within the space of this short article, to compare point for point the qualities of *F. elastica* and *H. brasiliensis*. Their main points of similarity and divergence will therefore have to be shortly epitomized.

Planting.—The *H. brasiliensis* is being planted out at distances varying from 15 to 20 feet. *F. elastica* can be planted out 8 by 6 feet, the yield per individual tree of *H. brasiliensis*, by most exhaustive tapping methods is said to have been raised to 10 to 12 lbs. per year. This statement looms largely in some prospectuses issued by rubber-planting companies, and is to be considered more as an exception —a very great exception—than a rule. It is safer to assume that an eight-to-ten-year-old Para tree yields one pound of rubber per year. In the case of Para this would give a yield per acre per year of 190 lbs. of rubber. In the case of *F. elastica* no claims of such high individual yields are made, but I have found, as the result of numerous tappings, that ½ lb. per tree per year is to be relied upon in an eight-to-ten-year-old tree. Thus, planted eight feet by eight feet, an acre of *F. elastica* would yield 335 lbs. of rubber, or 175 % greater yield than that same acre would have given, planted with Para 15 feet by 15 feet. Para requires a rainfall of 80 to 100 inches to do well; *F. elastica* gets along nicely on 55 to 60 inches per year. Para is liable to many diseases—canker, fungoid, blights, etc.; *F. elastica* is not liable to such diseases to nearly the same extent as Para is.† The difficulty of introducing Para into Africa lies in the great susceptibility of its seed to long transport. Planters in Africa, for instance, importing such seeds from Ceylon, even when most carefully packed, consider themselves lucky if they raise 15% of seedlings from the seeds imported. Large quantities of *F. elastica* seeds can be sent in a 11-lb. parcel for 3/- to any part of the world. We thus have the following advantages in the case of *F. elastica*:—

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*The natives have good reasons for not putting a better rubber on the market. They are intelligent enough to know that they can make more money out of the mixed rubber as at present exported, than out of the true article.—EDITOR, T.L.

† When Funtumia is planted out in large cultivated areas it may, and probably will, develop diseases the same as other trees—rubber, cacao, etc.

Section VI.—RUBBER.—*Continued.*

Seeds easily procurable; they stand transportation to any part of the world at small expense and do not necessitate cumbrous packing and consequent expense.*

F. elastica is a drought-resisting tree, doing well with a rainfall to which Para would inevitably succumb.

It is a disease-resisting tree, and not liable to the pests and cankers that have caused considerable ravage in the Para plantations of Ceylon.

The yield per acre of rubber from *F. elastica* is greater than from Para.

The mode of preparation and curing the latex of *F. elastica* rubber is simple, and does not necessitate any chemicals, which tend to weaken its resilient and elastic qualities.

Lastly, the price obtained for it in the open market has been practically the same as for hard Para, when prepared on equally scientific methods, and shipped free of moisture, dirt, etc.

A brief summary of the different methods of coagulating the latex of Funtumia may prove of interest to planters. There are several ways of carrying out this operation.

(1.) By the crude method at present in vogue among the natives This consists in digging a hole in the ground, or scooping out the trunk of a tree, and pouring the milk in. In three or four weeks the latex coagulates, and the rubber thus formed is then taken out and sent down to the coast and sold.

(2.) Next in order comes the boiling process. The milk is placed in a "bain-marie"; the water surrounding it is brought to the boil, and the water in the milk carefully steamed off. This process requires time, fuel, and constant attention.†

(3.) Then comes another process, considered by the writer very simple and effective. Several planks of the "Odoom" tree (Chlorophora excelsa) after being planed, are joined together, and the milk poured over this surface to a depth of about ⅛ inch. This is done in the evening. By the next morning the rubber is ready to be peeled off.‡

Fourth, and lastly comes the Otokotaka process, which has attracted so much attention of late.§ The milk is poured into an infusion made from the leaves of the Otokotaka shrub (Bauhinia reticulata) and stirred, coagulation immediately takes place. The rubber gathers on the surface of the vessel in grey white lumps. These are removed and rolled out into flat biscuits or sheets.

The writer has also successfully carried out the smoking and creosoting of these biscuits and sheets by dropping creosote on to the smouldering fibres that are left after the oil has been boiled out of the pericarp (fleshy part) of

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* We always understood that the Botanical Gardens supply plants at a price that works out under a penny each, so they cannot be said to be expensive.

Some authorities insist that Funtumia seeds also rapidly lose their germinating vitality.

† The process resembles the "Norzagary trough" process now on show at the stall of the Chilian Exploration Company in the Mexican Exhibition at the Crystal Palace. We have seen rubber prepared by this process, even in London, with great success. By this system the rubber can be prepared in about 30 minutes, and the apparatus (simply a tin pan and some troughs 12 ins. long) can be carried about anywhere. Mr. Evans values Funtumia prepared by a process similar to the "Norzagary" as being equal to hard Para.—[Editor, T. L.]

‡ We understand that this system is an old one, and from an experimental point of view it works out admirably, but is not generally to be recommended for commercial purposes. Any wood seems to do; it is the exposure to the atmosphere that causes coagulation, the length of time depending upon the thinness of the layer of the latex.

§ In the Gold Coast exhibits at the Franco-British Exhibition, Mr. Evans has included some Otokotaka leaves, and specimens of the rubber prepared by this process.

the nut of the oil palm. The smoke thus obtained preserves the rubber and gives it that peculiar smoked-bacon odour so highly prized by buyers.* The cakes of rubber were subjected to this smoke for about half an hour. I have one before me that has been on a steam radiator in an office during the past winter; its condition is perfect.

Tapping.—Experiments with spiral and semi-spiral tapping, after the methods used in Ceylon for Hevea, have given unsatisfactory results with Funtumia. The lactiferous system of the two trees cannot be compared. The milk-bearing tubes or cells of the Hevea are divided into well-defined compartments, running vertically, with very little, if any, lateral communication, so that a vertical cut produces very little latex. In the Funtumia, however, the tubes are longer and not divided to the extent that the milk tubes of the Hevea are. One vertical groove produces more latex than the same length of diagonal grooves, distributed over a wide surface. This points to their being horizontal, or secondary tubes in Funtumia, connecting the vertical or primary ones, and this is clearly proved by the microscope.

A series of vertical grooves made at intervals, say of two months, would at a distance of 4 ins. completely tap one tree in the course of a year without inflicting the damage that the spiral and herring-bone systems undoubtedly do. A knife made on the principle of the Ceylon V-knife, would be the best one to use. I find, however, that a slightly rounded apex cuts better and does less damage to the bark of the Funtumia.

In preparing an estimate for any forest or plantation venture on the Western Coast of Africa, it is quite useless and incorrect to count on any rubber coming from untapped trees on the property. A few untapped trees may exist, but they are very few and far between. The native rubber collector knows the value of an untapped rubber tree just as well as a man does, and has greater facilities to seek it out.—Tropical Life, Vol. IV, No. 8, August, 1908.

53.—Prospects of Rubber Cultivation.

Until recently the price of rubber was constantly on the up-grade, and plantation schemes always looked tempting. The old field of supply along the Upper Amazon had been so much used up that comparatively little accessible forest was left, and vast as the untouched districts are, the cost of collection and transportation rose to nearly two shillings per pound, which is considerably more than the cost on a properly conducted plantation in Ceylon or the Straits. It is no wonder, therefore, that rubber plantations multiplied and became a prominent feature on the Stock Exchange. In the latter half of last year, however, the demand for rubber fell off greatly, and the price went down from 5s. 6d. to 3s. 6d. The all-important question is, of course, whether it will go down or go up. So far as the supply is concerned, the main question is whether the wild Amazon Rubber will come more into the market. The output of this yield is still far and away the greatest: in 1905–6 it amounted to 41,000 tons out of the world's supply of 68,000; and growers have some natural apprehension that, notwithstanding the remoteness and present inaccessibility of unexplored fields, new means of transport may greatly increase the output and so bring down the price. But there are no signs of any movement of the kind, and on the whole it seems very unlikely that any extraordinary augmentation will take place in this quarter. Next to Brazil comes the Congo State, with about 4,500 tons, and, though the exportation has been steady for some years, it is known that a large part of the territory is now exhausted, and the supply must fall off until the plantations mature. The increase of plantations in our own possessions is too small a matter to affect prices for some time to come. It does not seem probable, therefore, that any serious fluctuation will be caused by the nature of the supply. The future depends on the demand, and it is clear now that there has been a certain amount of over-production in the industries using rubber, followed by a period of depression, which accounts for the fall in price. At present the price is rising, and in the long run it is much more likely to go up than down. Twenty years ago, when Brazil was the only, but an amply sufficient field of supply, the price kept

* Rubber can also be successfully creosoted on the West Coast by hanging the biscuits, etc., in a native cooking house.—[Editor, T.L.]

Section VI.—RUBBER.—*Continued.*

fairly steady between 2s. 6d. and 2s. 10d.; the extraordinary developments in the industrial uses of rubber sent up the price, and though set-backs will occur occasionally, as recently from a falling-off in the motor-car business, the tendency of the demand is bound to be upwards.

The effect of the ever-growing demands of civilization for tropical products may be illustrated by the fact that some 15 years ago the price of coconuts in the East was $13 per 1,000; it is now $40.

On the subject of the cost of plantations, an interesting report by Mr. N. C. McLeod, Deputy-Conservator of Forests in Southern Nigeria, based on a visit made to the Federated Malay States, has been laid before the Legislative Council of Southern Nigeria. Mr. McLeod states that rubber is being grown in the Federated Malay States on land previously under some other crop or in fresh clearings. In the former case the planter merely puts down his stumps or seedlings at any interval he fancies between rows of coffee, cocoa or sugar-cane, and, as the rubber trees grow older, gradually removes the original crops, thus affording more growing space to the rubber. The Para tree in the Federated Malay States is propagated by seed from trees at least eight or ten years old. Large quantities of seed are sent abroad which are obtained from trees of younger age, but the planter in the Peninsula prefers seeds from mature trees for his own use.

Mr. McLeod thinks that rubber plantations in Southern Nigeria would be very profitable. His calculation is as follows:—

"In the Malay Peninsula the average wage of a coolie is 27 cents per diem, which is equivalent in English money to seven pence half-penny, or about the same rate at which labourers by the month are paid in Southern Nigeria, so that figures given by Mr. Arden (pages 84-86, Johnson's book on Para) for opening up and maintaining a plantation in the Federated Malay States may be taken as a very fair guide.

"In the Federated Malay States, Para trees became productive in five years, but I propose to allow seven years in the case of Southern Nigeria.

"Cost of opening up 500 acres and maintaining till plantation is productive:—

"First year	...	$25,275	
"For next six years at $9,900	...	$59,400	
Total	...	$84,675	or £9,878 15

"Allowing compound interest at 4 per cent. on expenditure from the first year to the end of the seventh, would bring the total up to £12,694. If the trees are planted 20 feet by 20 feet, *i.e.* 108 to the acre, and the average yield per tree be taken as one and a half pounds per annum (6 months tapping), the yield would be (500 by 108 by $1\frac{1}{2}$ lbs.)—

"Selling price at 2s. 6d. per lb.

$$"= \frac{500 \text{ by } 108 \text{ by } 1\frac{1}{2}}{8} = £10,125$$

"If plantation expenses, cost of manufacture of rubber and freight to Europe be put down at £2,125 per annum (a very high figure), a handsome profit of £8,000 would result."

This calculation is pretty much in accord with the usual estimate of £20–30 as the cost of bringing a rubber estate to the productive stage per acre. In the Federated Malay States it is generally found that one coolie is required for two acres while the trees are growing, and one to each acre when they are producing. Labour is the principal item, and the cost and scarcity of labour is likely to prevent cultivation in Rhodesia and the Transvaal. In West Africa there is a great field, but the climatic conditions are unsuited to the private settler, and the work will be left to the native growers and to companies and syndicates which can acquire large areas and organise industry. The treatment is often slovenly, and the impurities found in West African rubber affect the price unfavourably.

The figures taken by Mr. McLeod in the above calculation seem to be on the safe side. He gives 108 trees to the acre, but 120 can easily be grown; and a yield of one and a half pounds per annum per tree, whereas 2 pounds are frequently obtained from a mature tree. The other crops which can be obtained while the rubber trees are growing, such as cassava, tapioca, or ground-nuts, may also be taken into account.—

54.—Another Rubber.

Great interest is being taken in Mexico in a newly discovered source of rubber. The palo colorado or cucuracho tree is stated to possess a sap which yields over 33⅓% of pure caoutchouc. It grows abundantly on the Pacific slopes of the Sierra Madre Mountains at an elevation of from 2,500 feet to 4,000 feet above sea level. The tree reaches an average height of 24 feet, and is from 8 inches to 14 inches in diameter. The tree is tapped in the same manner as the true rubber tree, and when tapped gives a thick white sap, which becomes semi-solid when exposed to the air. When tapped the larger trees produce over two pounds per day, but after one or two days run the cut has to be closed with clay, so as to allow the tree to regain its vitality.—West India Committee Circular.

55.—Report on Castilloa rubber from Tobago.

No. 23639.—39.

IMPERIAL INSTITUTE,
LONDON, S.W.,
10th February, 1909.

SIR,

I have the honour to enclose a report on a specimen of Castilloa Rubber from Tobago, which was shown at the recent International Rubber Exhibition in London and was afterwards transferred to the Imperial Institute by the Secretary of the West India Committee in London.

The other specimens of Trinidad Rubber exhibited were very similar to those which were the subject of the Report dated the 23rd December.

I have, etc.,

(Sgd.) WYNDHAM R. DUNSTAN.

His Excellency the Governor, Trinidad.

IMPERIAL INSTITUTE.

Results of the Examination of Castilloa Rubber from Tobago.

Imperial Institute.	No. 25639.	Date.	10th February, 1909.
Reference	Letter from the Secretary of the West India Committee in London dated 2nd September, 1908.		
No. of mark, and weight of sample.	No. 7a. *Castilloa elastica* sheet from Richmond Estate, Tobago; from the International Rubber Exhibition, London 1908. Weight 2½ lb.		
Description.	A square sheet of black rubber about ⅛ inch thick The rubber was clean, dry and well prepared, its physical properties were very satisfactory.		

Section VI.—RUBBER.—*Continued.*

Results of Examination.		*Sample as received.*	*Composition of dry Rubber.*
Moisture	per cent.	1·0	—
Caoutchouc	,,	91·1	92·0
Resin	,,	6·1	6·2
Proteids	,,	0·8	0·8
Insoluble matter	,,	1·0	1·0
Ash		2·20	2·22

Commercial value. Four shillings and four pence per pound in London with fine hard Para from South America quoted at 5 shillings per pound.

Remarks. This rubber is of good quality and would be readily saleable. It would realise a higher price if it could be procured lighter in colour.

Section VII.—CEREALS.

56.—Rice.

The extension of the cultivation of rice has resulted in the opening of a local mill with all the necessary machinery for the cleaning of paddy. It is worked by the firm of Messrs. Moralejo & Co., and is situated at the Old Ice Factory, La Basse. During a recent visit, the factory was seen to be well equipped and very busy turning out clean rice. For those who do not desire to sell, a small charge is made for cleaning.

The Imports of rice since 1900 are:—

Year.	lbs.
1900	20,253,000
1901–2	19,348,000
1902–3	21,812,000
1903–4	20,493,000
1904–5	23,696,000
1905–6	26,205,000
1906–7	20,603,000
1907–8	19,378,000

The local growth has not yet materially reduced the imports; it has, however, supplied the wants of the increased population.

The hulls are offered for sale as a cattle food.

The following analysis of this fodder was attached to a sample exhibited at the recent Port-of-Spain Agricultural Show:—

Composition of Rice Meal.

Water	9·66
Albuminoids	5·94
Fat	7·56
Woody Fibre	31·73
Ash	14·06
Carbohydrates	31·05
	100·00

Section VII.—CEREALS.—*Continued.*

57.—Maize.

This is another cereal which grows well locally; but large quantities are imported as the following figures show:—

Year.	Quantities.	Countries from which imported.				
		U.S.A.	Venezuela.	South America.	United Kingdom.	British West Indies.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1900...	43,458	42,912	120	...	...	426
1901-2	45,930	44,931	604	...	...	395
1902-3	42,053	35,196	5,244	1,000	400	213
1903-4	31,542	29,499	176	1,863	...	4
1904-5	41,411	39,390	88	1,000	857	76
1905-6	34,081	33,662	45	317	...	57
1906-7	37,476	30,323	5,278	1,344	400	131
1907-8	31,958	25,222	6,101	616	...	15

Section VIII.—COTTON AND OTHER FIBRES.

The following statistics will be of interest in connection with the probable early establishment of a local paper industry:—

58.—Imports of Paper—not Writing.

Year.	Total Value.	United K'ngdm.	British North America.	Other British Colonies.	U.S.A.	France.	Germany.	Other Countries.
	£	£	£	£	£	£	£	£
1900...	6,174	2,749	16	2	351	2,623	433	...
1901-2	8,245	2,947	33	126	819	4,054	148	118
1902-3	6,393	2,047	110	...	841	2,711	551	133
1903-4	7,718	1,950	183	...	941	3,562	941	141
1904-5	5,645	1,756	338	...	718	2,596	180	57
1905-6	7,105	1,765	326	14	956	3,895	149	...
1906-7	6,899	687	333	...	359	5,336	167	17
1907-8	7,369	1,520	620	2	774	3,911	390	152

Section VIII.—COTTON AND OTHER FIBRES.—*Continued.*

59.—Exports of Cotton from Tobago.

Year ending 31st March.	lbs.	Value.
		£
1905	2,956	74
1906	12,968	324
1907	11,139	291
1908	10,700	310
1909	13,503	

The present crop of Tobago Cotton largely exceeds any previous crop.

60.—Paper from Megass, &c.

Some people are apt to conclude that the preparation of paper from Cane fibre (megass) has only recently been attempted. A glance at the following list of patents for making paper from fibrous substances commonly grown in the Tropics will show that a patent was granted to Mr. Berry for the manufacture of paper from Sugar-cane exactly 70 years before Mr. Bert de Lamarre succeeded in doing so. During this long interval it evidently failed to be a paying industry probably because it was not rightly handled, or because conditions were unfavourable. The value of fibres has increased greatly during the 70 years :—

SOME PATENTS TAKEN OUT IN BRITAIN FOR MAKING PAPER FROM VARIOUS MATERIALS, WITH THE DATES.

(*Chambers's Encyclopædia.*)

Materials.	Names of Inventors and Dates of Patents.
Aloe Fibre	Berry, 1838 ; D'Harcout, 1838 ; Small, 1838 ; May, 1852 ; Burke, 1855.
Banana Fibre	Berry, 1838 ; Lilly, 1854 ; Jullion, 1855 ; Burke, 1855 ; Hook, 1857.
Cane (sugar)	Berry, 1838 ; Coupier, 1852 ; Johnson, 1855 ; Jullion, 1855 ; Ruck and Touche, 1856 ; Hook, 1857.
Coconut Fibre	Newton, 1852 ; Holt and Forster, 1854.
Coconut Kernel	Diaper, 1854.
Cotton	Bladen, 1682 ; Williams, 1833 ; Coupier, 1852 ; Crossley, 1854 ; Siblet, 1857.
Grasses	Stiff, 1853 ; Evans, 1854 ; Clift, 1854 ; &c., &c.
Maize, Husk and Stems ...	D'Harcout, 1838 ; Balmano, 1838 ; Ruck and Touche, 1857.
Manilla Hemp or Plantain Fibre...	Newton, 1852.
Tobacco Stalks	Adcock, 1854.
Wood	Koops, 1801 ; Desgrand, 1838 ; Brooman, 1853 ; &c., &c.

Section VIII.—COTTON AND OTHER FIBRES.—*Continued.*

61.—Examination of Fibres.

The following Fibres were examined:—(1) Fibre of *Sanseviera* species probably *Sanseviera guineensis*. The soft white fibre, about 3 ft. 9 in. long was valued at £60 per ton. (2) Plantain fibre (*Musa sapientum*). The fibre was brownish white, of fair strength, and about 4 feet long; it was worth £40 per ton as compared with £38–£42 for good Manila hemp. (3) Banana fibre (*Musa sapientum*). This was similar to the plantain fibre and was valued at £36 per ton as compared with £35–£36 for fair Manila hemp. (4) Fibre of *Triumfetta semitriloba*. The fibre was soft, of a pale buff colour, and 5 feet long, the length of the ultimate fibre being 0·04—0·14 inch; it was worth £35 per ton, as compared with £35–£40 for finest Bengal jute. (5) Pine-apple fibre (*Ananassa sativa*). The soft white fibre about 3½ feet long was valued at £30 per ton, and might perhaps be used as a flax substitute. (6) Kapok (*Eriodendron anfractuosum*). The specimen was inferior to good commercial kapok. The results of the chemical examination of the first five fibres are shown in the following table:—

	(1)	(2)	(3)	(4)	(5)
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Moisture	10·3	10·5	10·1	10·3	9·5
Ash	0·2	0·9	0·8	0·8	1·1
(*a*)—Hydrolysis (loss)...	8·8	12·1	13·0	7·3	13·7
(*b*)—Hydrolysis (loss)...	10·5	19·7	20·7	10·4	19·4
Acid purification (loss)..	1·4	1·6	1·3	0·6	1·7
Cellulose	81·8	77·0	74·0	73·5	81·5

(Bulletin Imperial Institute.)

Section IX.—SOILS.

62.—A rich soil (Guanapo).

The soils of Trinidad are varied in character, but on the whole so far as the more important constituents are concerned the variation is not great. One can almost always give an approximate estimate of the percentages of Lime, Magnesia, Phosphates and Potash in a soil; and if these normal proportions are departed from, the soil has probably gone out of cultivation, either because it lacked the necessary supply of essential constituents or, possessing these, was wanting in other conditions of fertility. Peaty soils in Trinidad are confined to lagoon areas. They are exceptionally rich soils, but as a rule their water retaining power is very great, and heavy drainage is required.

A soil of this class has recently been brought to the notice of the Department of Agriculture. The fact that it has been is evidence of the awakening of an intelligent interest in the chemistry of the soil; and so unusual were the results of analysis that I visited the spot to study its geological formation.

The soil occupied the basin of what was evidently an old lagoon, it was spongy and black, full of decaying and decayed mangrove roots, and exuding water in abundance which left in its track a brown deposit either of oxidised iron salts or the natural colouring matter of the mangrove. The surplus water was led to lower ground and was very wisely utilised for irrigation purposes. It is probably very rich in manurial constituents.

If the soil could be cheaply deported it would form an excellent mulch for soils poor in organic matter which are so commonly met with even in the immediate neighbourhood; but the cost of transportation would probably prove unremunerative. It is, therefore, advisable to endeavour to utilise its peculiarities on the spot. Although it is essentially a black soil, and capable of absorbing a large amount of heat, shade should not be required to any great extent as the water naturally retained by the air dried soil amounts to 21 per cent. With the present system of drainage it will steadily improve, and with an occasional light application of lime it will give abundant yields. There are other similar soils in the Colony;

Section IX.—SOILS.—*Continued.*

but so far as is known they have not been analysed. It is very probable that soils in the neighbourhood of the Oropuche lagoon are deserving of attention.

The richness of the soil in phosphates and organic matter, and its poverty in lime are remarkable. So also is the large amount of injurious chlorine in the sub-soil.

G. F. HUGGINS, *Esmeralda* Estate, Guanapo.

	Soil.	Sub-soil.
Water	21·300 ...	18·880
*Volatile matter...	48·700 ...	48·120
Oxides of Iron and Alumina ...	13·929 ...	16·035
Lime...	·017 ...	·017
Magnesia	·050 ...	·060
Potash	·202 ...	·186 (·200 by [Tatlock).
Soda	·093 ...	·130
Phosphoric anhydride	·701 ...	·960
Sulphuric ,, ...	·151 ...	·093
Chlorine	·006 ...	·025
Insoluble silica and silicates ...	14·851 ..	15·494
	100·000	100·000

* Containing :—

Total Nitrogen	1·31 per cent. ...	1·34 per cent.

Available Plant Food.

Potash	·0150 per cent. ...	·0135 per cent.
Phosphoric anhydride	·1165 ,,	·1638 ,,
Nitrogen as Nitrates	·0025 ,,	·0022 ,,

63.—An unusual soil (Caroni).

The following analysis of a soil in which canes were badly diseased with blight is instructive on account of the fact that the percentage of magnesia exceeds that of lime, and affords additional evidence of the disadvantages that have been observed to follow when magnesia is in excess of lime in a soil. A fuller report on this soil will be issued by the Committee on Cane Blight:—

SOIL FROM CARONI.—(CANES STRONGLY ATTACKED BY BLIGHT.)

Water	7·720
Loss on ignition	8·140
Soluble Silica	·480
Oxide of Iron and Alumina	10·528
Lime	·336
Magnesia	·520
Potash	·298
Soda	·138
Sulphuric anhydride	·051
Phosphoric anhydride	·192
Chlorine	·002
	28·405
Insoluble silica and silicates	71·595
	100·000

Containing :—

Total Nitrogen	·159 per cent.

Available Plant Food.

Potash	0·0089 per cent.
Phosphoric anhydride	0·0224 ,,
Lime	0·2080 ,,
Nitrogen as Nitrates	0·0008 ,,

Section IX.—SOILS.—*Continued.*

64.—Short Treatise on Drainage.

(LUDOVIC DE VERTEUIL.)

The functions of draining cultivated lands are not as well understood by many agriculturists in the Colony as they should be. Of all the tillage operations, perhaps this is the one less studied because drainage is regarded as having for its sole end the removing from the soil of the water which may be in excess and which renders it swampy and water logged, but the more important effects of that operation are lost sight of.

To thoroughly comprehend what is meant by drainage, it is necessary, in the first place to show the part played by water in the phenomenon of vegetation and the influence it exercises in the fertility of soils, and then to examine the circumstances which cause its presence to become at times, a serious impediment to the growth of plants.

I.—The part played by water in vegetation.

The richness of a soil does not depend exclusively on the proportion of mineral or organic matters it holds in reserve for the nutrition of plants, but it is indispensable that the soil should contain a certain amount of moisture, without which plants would be entirely deprived of their food. Water dissolves the solid ingredients constituting manures and transports them to all parts of the plant; it decomposes the organic matters and renders them assimilable; it helps to swell the tissues of plants to facilitate their movements, and last but not least, it is resolved into its elements, Hydrogen and Oxygen, so essentially necessary to the life of vegetables. Rain water carries with it, by passing through the atmosphere, air and other substances which enrich the soil.

II.—Degree of Moisture the soil ought to contain.

Since water is an indispensable factor in the physiological functions of plants, it is necessary for the good cultivation of soils to find the limit beyond which it becomes harmful and must be removed by drainage. That limit, can be determined when the composition of soils is known, because, they are formed of different substances, among which, clay, lime, and humus, have the property of retaining in their pores a varying quantity of water, according to their nature. When, on the other hand, the physical constitution of soils is considered, they are found to be made up of an infinite number of particles, very different in forms and dimensions varying from the grains of sand visible to the naked eye, to the tenuous and impalpable parts composing argillaceous soils. These elementary parts conglomerate in the ground and leave between the clusters, so to speak, spaces called *interstices*, to distinguish them from those that exist in the particles themselves and which I call *pores*. In other words, the soil can be compared to a porous mass, or sponge.

When rain falls on dry land it penetrates the interstices, but is quickly absorbed by the pores and a quantity can thus be taken in without affecting its porosity. Under these conditions the soil is said to be *moist* and that is the degree best suitable to vegetation. But if more rain continues to fall on a moist soil, the pores become saturated and the interstices in turn are filled, and the mechanical constitution of that soil is very much altered, it loses its porousness and become *damp* and impermeable to air, and if this state of things continues for any length of time, it compromises the growth and development of plants. The water which fills the interstices is the one to be removed by drainage.

III.—Causes which diminish the fertility of damp soils, and their productiveness.

The earth we cultivate can be compared to a laboratory in which Nature prepares the food for the plants; organic and inorganic matters are transformed into soluble and assimilable substances. These transformations can only be accomplished by the simultaneous concourse of heat, air, and moisture. Anything that tends to exclude any one of these agents or

to diminish its action, must inevitably hinder and modify to a certain extent the chemical reactions upon which hinges the whole system of plant alimentation. When the land is saturated with water, air cannot circulate freely, and heat is lost by the evaporation and the radiation which take place on its surface. To ensure the circulation of air, it is essentially necessary that the moisture should take the form of moving water and this can only be attained by thorough drainage. Rain which comes down through the atmosphere is rich in nitrogen, ammonia, nitric acid, carbonic acid, and other nutritious elements, and when it reaches a soil which cannot admit the free circulation of these beneficial showers, it flows on the surface and carries with it the fertilizing agents it holds in solution as well as those contained in the soil.

Another cause which militates against the fertility of damp soils is to be found in the difficulty experienced in carrying out tillage operations. No Agriculturist can ignore the beneficial effects derived from a proper mechanical division of the soil. Ploughing, forking, harrowing, weeding, enable the roots of plants to penetrate the soil in search of the food they require; they expose the lumps to the atmosphere and thereby assist the condensation and absorption of gases; they facilitate the disintegration and decomposition of mineral and organic matters. With the knowledge we have to-day of soil bacteriology, it can at once be seen, how important these operations must be, and it is not possible to carry them out in a compact and damp soil.

A third cause which affects the fertility of a damp soil to a very sensible degree is the loss of heat due to the stagnation of water at a few inches from the surface. When water is exposed to air, it evaporates at almost all temperatures and in the case of a damp soil that evaporation can only take place at the expense of the heat contained in the earth; because it is a well known law of Natural Philosophy that when water passes from the liquid state to that of vapour it borrows heat from the body with which it is in contact. The earth derives most of its heat from the sun, and as water is a bad conductor it also follows that in a damp soil, the heat is not transmitted through it to the sub-soil. If water is a bad conductor of Caloric its radiating power on the other hand is very considerable. What is here meant by radiation is the power that water has to emit heat. Every body knows that when a quantity of hot water is placed under conditions of a surrounding lower temperature, it cools down very rapidly; this takes place in a damp soil and is another serious cause of loss of heat.

A fourth cause affecting the fertility of damp soils is to be found in the loss of the beneficial action of dew. In a climate like ours, too much importance cannot be attached to this. Dew is very abundant at certain seasons of the year when it is most required, it contributes powerfully to maintain a well-drained soil under conditions favourable to vegetation.

A last cause due to excessive dampness is to be found in the danger of the spread of fungoid and other diseases, and the multiplication of certain insect pests so prevalent in our climates, and both so injurious to crops.

IV.—Origin of the water to be removed by drainage.

Excess of dampness in soils is due to two principal causes: (1) Springs which elevate the sub-soil water to the surface; (2) the accumulation of rain water on strata of a particular nature. In the first case it is necessary to intercept the springs before the water gets to the surface, and in the second case, which is by far the most common, a thorough system of drainage must be adopted. In referring to strata of a particular nature it is well to distinguish between the retentive power of certain soils for water and their *impermeability;* these two things are often confounded. Clay or argillaceous soils are generally considered as imperme-

able because their *retentive* power is so great they do not allow water to circulate freely, but under a thorough system of drainage they become permeable. The term impermeable is more applicable to plastic clays which form the sub-soil of certain lands and are often the cause of land-slips. A special system of drainage is there required cutting right through the strata or preventing the flow of water from reaching them. Sand and gravel have very little affinity for water, their particles do not increase in volume, when they come in contact with it they form large interstices which allow water to filter easily; such soils do not require to be drained.

V.—How to know lands which require draining.

Apart from the chemical composition of the soil and sub-soil there are other indications which reveal the necessity for drainage. They can be drawn from :—

(*a.*) The nature and the state of the surface soil at the different seasons of the year. During the wet months the land becomes soft, yields easily under the pressure of the feet, is sticky, muddy, and covered with puddles; whilst during the dry months the land cracks and forms large crevices.

(*b.*) Cultivated plants on lands badly drained show want of vigour, have a struggling appearance, are yellowish in colour, and often give signs of disease.

(*c.*) The species of plants growing spontaneously on the land such as rush, reed, sedges, etc., are sure signs of the necessity for drainage.

(*d.*) Wherever a hole dug 3 or 4 feet deep gets filled during the wet season with water which stagnates for a length of time.

VI.—The way drains act.

Drains do not only remove the surface water as many are inclined to believe, but the greatest quantity of the liquid which comes into the drains oozes from the sides. The sides of the drains require attention at least once a year, as owing to the heavy rains and hot sun the surface cakes and becomes impervious to water. It is not by suction or in virtue of any particular attractive force that this is done, the sole function of drains is to maintain a vacuum so as to allow the laws of gravitation full play on the liquids contained in the soil to facilitate their flowing out. It is necessary here to remark that drains cannot remove all the water contained in the earth; that which renders it moist and is held in the pores as already explained is there retained by the natural forces of affinity and *capillarity* the effects of which cannot be destroyed by drainage. Capillarity is that force which causes liquids to rise in a porous mass, it is the same phenomenon which explains how coffee or any other liquid can rise in a lump of sugar as soon as it comes in contact with it. It is by this natural force that, in well-drained lands rendered porous, a sufficient supply of moisture is kept in reserve for the use of plants.

It may appear paradoxical but there is no danger of excessive draining in the clay soils of this Colony, and it is a fact that cultivated plants suffer less from drought in well-drained lands, because under such conditions the roots finding no obstruction in the way of stagnant water penetrate deeply into the soil forming numerous small perforations which enable earthworms to get down and disseminate both air and moisture; and as the land does not contract and form fissures, the roots are not exposed to be compressed, torn and otherwise damaged.

From what is said above it should be easy to understand how important it is to have recourse to deep drains. Two to three feet is not excessive in the great majority of soils found in this island and particularly in the case of the cultivation of cacao trees.

Section IX.—SOILS.—*Continued.*

VII.—Hills should be drained.

Clay and loam constitute the bulk of our arable soils. The loam prevails in the vegas whilst the clay is more common in our undulating soils. What has been said in the foregoing chapters refer more particularly to the drainage of the vegas and low lands, but our hilly clay soils require just as much drainage. The important question to be considered when hills are to be drained is the direction the drains should take so as to render them effective. They must be placed obliquely to the inclination following as much as possible the levels of the undulation, this will then make them appear on the ground like a series of broken lines. Sufficient declivity must be given the drains to make the flow of water easy, but guarding at the same time against any undue rush.

VIII.—Sub-soil Drainage.

Just a word on this system which offers undoubted advantages when compared to our open system of drainage, but after repeated trials in this Island the drainage by means of underground earthenware tubes, proved a failure probably due to our excessive rainfall which caused constant choking of the tubes by earth.

In this country it would be sometimes advantageous to use stones and coarse gravel in the construction of drains where the land is liable to slip and has a weak consistence, and where these materials are easy of access.

Section X.—MANURES.

The Ordinance recently passed for the protection of purchasers of manures gives additional importance to the following figures of—

65.—Imports.

Year.	Total Quantity.	United Kingdom.	British West Indies.	Other British Colonies.	Holland.	U.S.A.	Venezuela.	Other Countries.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1900 ...	4,632	3,426	631	...	..	100	...	475
1901-2 ...	3,362	2,702	217	...	443	...	...	...
1902-3 ...	2,892	2,456	248	...	185	3	...	...
1903-4 ...	2,818	2,698	97	15	...	2	6	...
1904-5 ...	3,786	3,150	175	...	32	...	289	140
1905-6 ...	3,315	2,780	155	3	...	189	188	...
1906-7 ...	3,351	3,087	94	1	...	7	158	4
1907-8 ...	3,862	3,336	236	...	20	25	170	75

66.—A new use of "Gliricidia maculata" or "Nicaraguan Shade Tree.

For some considerable time I have been experimenting with this tree, and found that it grows much quicker from cuttings than from seed. In a few months, when grown from cuttings, it flowers and bears pods: these cuttings also grow well under cocoa trees.

In addition to whatever value it possesses as a shade tree for cocoa it is also very valuable as a mulch and nitrogen introducer for the soil. I have grown successfully 95 per cent. of the slips planted 12 feet apart.

Section X.—MANURES.—*Continued.*

Whenever the top branches of "Gliricidia" reach under branches of cocoa trees its branches can be cut and used as a mulch. A considerable quantity of green manure is thus secured ready to hand, which in addition to keeping weeds, etc., in check, gradually improves even the poorest land. Before being cut the branches also act as a wind break to the trunks of cocoa trees, especially in the dry season, and thus prevent much evaporation of moisture from surface of the soil. As a shade the "Gliricidia" grows in a very long straggling form unless topped at height desired, which enables the tree to spread more.

Any one wishing to secure a temporary shade in advance of planting a large cocoa area, can do so at a very moderate cost by planting cuttings at distance considered necessary according to quality of land he is dealing with.

The analysis of leguminosæ shade trees, such as this,* should be both interesting and valuable. If you think it worth while I can send you some for that purpose. If you think it would be of use, I can send later a paper on results of experiments with "Crotalaria striata" and "Albizzia Lebbek."

J. P. Bain.

Section XI.—PLANT DISEASES.

67.—New Fungus Diseases.

Eutypa erumpens, &c.

While visiting an estate at Santa Cruz lately, I came across a recently fallen cacao tree the bark of which displayed large masses of fruiting spores of a parasitic fungus—*Eutypa erumpens* (Massee). As there are no previous records of this disease attacking cacao, it is desirable to call attention to this destructive wound parasite.

The large banyan facing the Queen's Park Hotel was destroyed by this fungus, and lately another banyan tree near the Savannah Cemetery has succumbed to the same pest. It has also been the cause of the death quite recently of a *pain d'epice* (Lucuma multiflora A.D.C.) and *Mango vert* tree at Cascade, both of which last year were bearing profusely and in an apparently healthy condition. It is stated on good authority to be responsible for the death of many local forest trees, and I have met it quite commonly on fallen trees and cut logs in the Cascade Valley. Two dying Litchee trees (Nephelium Litchi) recently examined in the Botanical Gardens proved to be affected by this fungus. They have since been cut down.

Externally this fungus is readily recognisable by forming irregular black patches on the bark with a dull grainy surface varying in size from a three-penny piece to a diameter of two or more inches. Any dead trees or branches bearing these characteristic markings should be cut out, and either be burnt or buried.

While recording the occurrence of this parasitic disease it may also be mentioned that *Diplodia cacaoicola* was recently found by the writer on grape cuttings from a vine said to be suffering from dieback and on dying twigs of a rose plant. On an ear of Indian corn from Cumuto *Diplodia maydis* was found.

It may also be placed on record that *Nectria theobromæ* (in fruiting stage) was found on the exposed roots of Gliricidia maculata (Nicaraguan Cacao Shade) and stems of mangoes and Avocado pears, all of which were growing near some cacao trees affected by this disease. A species of Coprinus on diseased grape stalks has also to be recorded.

A. E. Collens.

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* The flowers have been analysed at the Government Laboratory and found to contain from 2·40 per cent. to 3·36 per cent. of nitrogen. The flowers of the Immortelle trees contain from 3 to 4 per cent.

Section XI.—PLANT DISEASES.—*Continued.*

68.—Cacao Pests.—(A. E. Collens.)

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment.	
			Preventive.	Remedial
Fungus Pests:				
Leaves ...	*Thread Blight.*—(Pellicularia koleroga and other types.)	*Under surface* covered with fine thread-like brownish fungus—traceable back to stem and base of tree.	Fallen leaves from affected trees gathered and burnt.	Spraying affected leaves with Lime-Sulphur wash.
Insect Pests:				
Leaves ...	Leaf borer. A small beetle and also caterpillar of a small moth.	*Young leaves* riddled with small irregular holes.		If damage extensive, spraying with Lead Arsenate mixture, half-pound to 50 galls. water.
Do. ...	*Thrips.* — (Physopus rubrocincta.)	*Under surface.*—Brown scabby appearance, leaves become yellow and dry.	Burn fallen and dying leaves (to destroy eggs and immature insects.)	Spraying with Rosin wash.
Do. ...	*Parasol Ants.*—(Atta cephalotes and Atta Sp.)	Semicircular pieces clipped out of *leaf edges.*	Destroy nests with carbon disulphide.	
Fungus Pests:				
Stems and Branches...	*Canker.*—(Nectria theobromæ. Calonectria flavida.)	*Stem and bark sickly.* Reddish sap oozes from cut, discoloured rusty stain on bark. Finally small red bodies like pin heads appear.—The fungus fruits.	Burn or bury all dead wood and diseased parts. Spraying with Bordeaux Mixture.	Cut out all diseased portions till healthy wood exposed. Apply, tar, solignum or other cheap antiseptic to cut surface.

Section XI.—PLANT DISEASES.—*Continued.*

Cacao Pests.—*Continued.*

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment. Preventive.	Treatment. Remedial.
Fungus Pests:				
Stems and Branches.	*Dieback.* — (Diplodia cacaoicola.)	*Young twigs and branches* die out. Disease spreads backwards. Small curling white and black hairs sometimes observed. These contain the spores or fungus seeds.	Improved cultivation.	Cutting back all dying branches to the healthy wood. Tarring cut ends.
Leaves (& Cushions.)	*Witch Broom.* — (Colletotrichum luxificum.)	*Young branches* become swollen in parts, several adventitious shoots spring from them, finally cluster of small twigs resembling a sea rod or a broom formed.		Cut out and burn such tufted masses of twigs, tar ends and spray tree thoroughly with Bordeaux Mixture.
Insect Pests:				
Leaves ...	*Large Beetle borers.*—(Steirastoma depressum and Trachyderes succinctus.)	*Trunk and large branches.* Holes in bark with small chips like sawdust extruding.	Collect and kill adults. Trap adults by tying bagging or coarse bark round tree trunks.	Larva and pupa killed and withdrawn by barbed probe. Tar wounds.
Stems and Branches.	*Small borer Beetle* (shot borers)—(Xyleborus perforans and Tomicus Sp.)	*Bark and inner wood* tunnelled, more usually dying wood.	Cut out and burn dying and cankered wood to destroy existing borers and get rid of sources of attraction.	Difficult, but chiselling out borer tunnels and tarring might answer.
Do. ...	*Twig girdler Beetle.*—Ecthoea quadricornis.)	*Twigs and small branches* are killed by a circular groove or girdle formed by the girdler which prevents flow of sap.	Collecting and destroying beetle when found in the act.	Burning all girdled branches. Eggs and larvæ occur in these.

Section XI.—PLANT DISEASES.—*Continued.*

Cacao Pests.—*Continued.*

arts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	TREATMENT. Preventive.	TREATMENT. Remedial.
Fungus Pests: *Pods*	*Black rot.*—(Phytophthora cmnivora.)	*Pods* turn black and hard, later they become coated with a white mildew composed of spores which can spread immediate infection. When the pod rots another type of spores called resting spores are liberated. Thus the disease is carried over from one crop to the next.	Pick and carefully collect all black or whitened pods. Such pods should be buried or burnt.	
	Brown rot.—(Diplodia cacaoicola.)	*Pods.*—Small brown spots appear and spread rapidly over pod which becomes soft or rotten. Pod next becomes coated with a white powder which afterwards turns black and resembles soot. This powder is composed of millions of two different types of spores capable of growing in two hours if favourably situated. *Note.*—These spores are produced in immense quantities on old broken pods. Such heaps are consequently a great source of danger, as this disease attacks both pods and branches.	Shells of broken pods should not be allowed to rot on ground, but should be covered with lime and then with a layer of earth. Diseased pods should be picked and buried.	
	Pod canker.—Nectria Bainii Calonectria flavida.	*Pods* first turn brown subsequently become hard and dry. Later stage, red points like pin heads appear in clusters.	*N.B.—The safest preventive treatment to adopt against any pod disease is to spray the young pods at intervals with Bordeaux Mixture.*	
	Witch Broom.-Colletotrichum luxificum, n. Sp.	*Young pods and flower clusters.* Swellings appear on sides of pods, stalk unnaturally enlarged. Pods get hard and woody inside. Subsequent sinking in of skin and whitish mildew develops.		Cutting out and burning all affected pods, flower clusters and young stems. Tarring ends and spraying.

Section XI.—PLANT DISEASES.—*Continued.*

Cacao Pests.—*Continued.*

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment.	
			Preventive.	Remedial.
Insect Pests:				
Pods ...	Thrips.—(Physopus Sp.)	*Pods* have a spotted appearance. Small black or yellowish (young) narrow insects, red band in centre, very pointed behind, about 1-20th inch in length, may be seen crawling on the surface. They damage the pod by puncturing it, and may thus permit disease to enter. The discoloration produced may cause pickers to mistake unripe pods for ripe ones.		If only a few pods are attacked and these are easily accessible, the insects can be brushed off into a tin with some water and a little tar or pitch oil on top. If in large numbers, and several trees affected, a spray of Resin wash or Resin Compound should be at once applied.
	Aphides or *Plant lice.*	*Description of Insects.—Very soft small green or olive-coloured insects, winged or wingless.*		
	The *pod hopper* or *cacao bug.* (Horiola arquata and Horiola Sp.)	*Conical insects about ¼-inch long, the back is of polished brown or chocolate colour, with light wavy lines. These insects jump with a sudden spring when disturbed.*		
	Mealy bugs.—(Dactylopius Sp.)	*Round soft pink insects covered with a white mealy powder, they are very sluggish in movement. These insects suck the juices of the pod and so weaken it, they also allow fungus diseases to enter. N.B.—They are always accompanied by ants, which guard and protect them, sometimes building covers of mud for them.*		

Cacao Pests.—*Continued.*

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment.	
			Preventive.	Remedial.
Fungus Pests:				
Roots	*Root disease.* — Lasiodiplodia Sp. (diplodia cacaoicola) and other types.	*Roots*—black, often decayed; often white threads of another type of root disease observable. Trees sickly, leaves small and yellowish. Branches begin to wither from tips.	Isolation of unhealthy trees, application of lime, and thorough draining.	Remove and burn badly diseased trees, roots and all. Unhealthy trees isolated by a trench. Remove soil from around base and cut out diseased roots, spread about 5 lbs. quicklime on hole and replace soil; thoroughly drain isolated area.—N. B.—Root disease is always accompanied by bad drainage.

Section XI.—PLANT DISEASES.—*Continued.*

69.—The principal diseases of the Sugar Cane.—A. E. Collens.

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment. Preventive.	Treatment. Remedial.
Fungus Pests: *Root System* ...	Root rot—Marasmius Semiustus..	Growing portion of roots. Plants readily uprooted. White threads often visible among roots. Dead leaf sheaths matted together by a white cobweb or mildew. In older canes—this typical matting is only observed near the root system. Leaves begin to die back from tips and edges. Later on the whole leaf system becomes withered or blighted. At a later stage, small toad stools about ¼ inch in length, and diameter are produced on the dead leaf sheaths near the base of the cane. These are the fungus fruits and from them are produced the spores or seeds.	Proper cultivation and drainage. Only healthy canes should be planted. Cuttings from canes affected by borers, root rot or red rot should be avoided.	All trash and dead canes should be burnt as the fungus is capable of living on dead material till it can attack living canes. Quick-lime should be applied to unhealthy stools and well worked in with a fork. Attention should be paid to unhealthy surroundings especially water-logged and badly drained soils.

"*It should be clearly understood that the presence of root and other diseases indicates that the plants themselves are in an unhealthy condition, and that this condition is brought about (1) by inherited weakness, i.e., from taking cuttings from worn out ratoon stools, and from canes affected by borer and disease; or (2) by unhealthy surroundings—the accumulation of injurious ingredients in the soil, and stagnating water in waterlogged and badly drained soils. Healthy canes can always manage to throw off fungus diseases unless these are accompanied by severe and persistent insect attacks.*"

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment. Preventive.	Treatment. Remedial.
Stem ...	Rind or stem disease. Red Rot.	Found in canes that are damaged or attacked by borers—also in canes planted from infected cuttings.	Avoid using cuttings which show borer holes or a red colour at the cut ends.	Cut out and burn any canes observed with this disease. This disease cannot attack sound and healthy canes. If however, cuttings from canes attacked by red rot are planted, the disease will spread from the cuttings to the young shoots, and if the canes cannot grow quickly enough to outgrow the disease, the whole stool or whole field may be destroyed.
	Colletotrichum falcatum—Howard and Went.	Inside of cane reddened in patches sour but pleasant smell. (Red colour called locally borer or borax).	Plant freshly cut cuttings, do not allow them to stand over for any length of time.	
	Trichosphæria sacchari—Massee.	Outer leaves dry up first, finally whole top withers. Small black projections like pinheads appear and protrude in black curly hairs, composed of millions of spores of seeds glued together. These—though not the actual cause—are a sure sign that the cane is infected by red rot or rind disease.	Cuttings should be soaked for 12 hours in Bordeaux Mixture, or failing that either use a mixture of (temper or slaked) lime and water or dip the ends in tar.	

Section XI.—PLANT DISEASES.—*Continued.*

The principal diseases of the Sugar Cane—*Continued.*

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment.	
			Preventive.	Remedial.
Insect Pests: *Stems.*—Underground portion.	Cane Sucker moth—(Castnia licus Fab.)	Caterpillar tunnels in underground stock and also to about 12 or 18 inches above ground, then retraces and works its way into another plant. One caterpillar may thus damage several canes. The chrysalis or pupa is enclosed in a cocoon made from the fibres of the cane.	Destroy adults and caterpillars whenever seen. The adults are ready to lay their eggs about November, and each female may lay 50 or more eggs. Cover cane stumps with earth, after cutting the canes.	As the boring starts from underground and the ravages are invisible until the cane is cut,—no satisfactory method of getting at caterpillar is known.
	Weevil borer—(Sphenophorus sericeus	Eggs embedded in cane, larva tunnels inside cane, larva easily recognised by peculiar hump near anal extremity.		Cut out infested canes. Cover over ends of cut canes.
	Smaller cane moths—Diatraea saccharalis and Elasmopalpus lignosellus.	Eggs laid in clusters on cane leaves, young caterpillars crawl down and tunnel into cane joints. Adult small, straw coloured or ash coloured wings.	Search for egg cluster destroy them, by exposure to sunlight, in bare spots where the young caterpillars if they emerge can find no food. By doing this any parasites present in the eggs, will not be destroyed but can fly away, on emerging.	Cut out dead and dying canes affected by these borers.
	Shot borers—Xyleborus perforans	Small beetle, about $\frac{1}{8}$ inch attacks, diseased or thin rinded canes, eggs are laid in the tunnels.	Cut and burn all canes showing the entrance and exit holes of these borers.	
Leaves and roots ...	Frog hopper—Tomaspis postica...	Adults attack leaves, piercing them with their beaks and sucking the sap. Young nymphs or larvæ attack the young roots, feeding on the sap, the latter cover themselves with a froth or spittle as a protection. This spittle contains potash.		Attract and destroy adults by means of trap lights. Apply quick lime to stools and earth up freely, this will bury existing nymphs and encourage the plant to throw out fresh rootlets.
	Cane fly—Delphax Saccharivora and plant lice—Aphis sp.	Under surface of leaves. Small green bug, long tail These are usually found on unhealthy plants.	Usually kept under control by natural enemies..	Encourage ladybird beetles the adults of these as well as their larvæ and the larvæ of the lace wing fly feed upon these insects.

Section XI.—PLANT DISEASES.—*Continued.*

Formula of Resin Compound.

Powdered Resin	2 pounds.
Powdered Washing Soda	1 pound.
Water to make	10 gallons.

Place the washing soda and resin in a kerosene tin, or other vessel with enough water to cover them, and boil. Add water a little at a time stirring constantly. The liquid at first is thick and soapy, but after boiling for some time it becomes thin and clear and of a deep brown colour. After boiling for half hour or longer add a few drops of the liquid to some cold water, if it does not turn cloudy but remains a clear brown, the wash is ready for use, and can then be diluted to make 10 gallons.

Kerosene Emulsion (hard soap).

Dissolve half-pound of hard soap in one gallon of boiling water. Add two gallons of kerosene to the hot liquid and immediately churn, with a syringe or force pump, till the mixture becomes creamy. This is the stock solution. Make up to 33 gallons. Use only rain water or soft water (*i.e.*, without lime, etc.)

Kerosene Emulsions.– (A new formula).

The soap kerosene emulsions are rather difficult to prepare, and when diluted to spraying strength, do not keep well for more than two or three days. An emulsion that can be immediately prepared, and will keep indefinitely, is a great advantage. The following can be recommended for trial, but should be used with caution until its effects are better known. It has also this advantage that it can be made of any strength required. Supposing a 6 per cent. kerosene emulsion is required, 6 volumes of kerosene are taken and mixed with 2 volumes of Lysol, the mixture is then added slowly to 100 volumes of water with constant stirring.

Kerosene-Lysol Emulsion (Carmody).

Kerosene	6 volumes.
Lysol	2 ,,
Water	100 ,,

Experiments have shown that 1 volume of Lysol will emulsify 3 volumes of kerosene in the manner above described.

The above solution is, on account of the germicidal properties of the Lysol, fully equal to a *ten* per cent. kerosene emulsion, and in some cases would require to be further diluted before use.

Bordeaux Mixture.

Copper sulphate (Blue stone)	4 pounds.
Unslaked lime	4 ,,
Water	50 gallons.

The 4 pounds of copper sulphate are dissolved in 25 gallons of water in a wooden tub or barrel. At the same time 4 pounds of freshly-burnt unslaked lime are slowly slaked and the resulting paste made up to 25 gallons with water and well stirred. Next the lime wash and solution of blue stone are slowly poured together into a third tub or barrel holding from 60 to 70 gallons. (*Vide* cacao, Circular No. 1 for detailed description).

Section XI.—PLANT DISEASES.—*Continued.*

The principal diseases of the Sugar Cane—*Continued.*

Parts attacked.	Fungus and Insect pests.	Parts affected and symptoms.	Treatment. Preventive.	Treatment. Remedial.
Insect Pests: *Stems.*—Underground portion.	Cane Sucker moth—(Castnia licus Fab.)	Caterpillar tunnels in underground stock and also to about 12 or 18 inches above ground, then retraces and works its way into another plant. One caterpillar may thus damage several canes. The chrysalis or pupa is enclosed in a cocoon made from the fibres of the cane.	Destroy adults and caterpillars whenever seen. The adults are ready to lay their eggs about November, and each female may lay 50 or more eggs. Cover cane stumps with earth, after cutting the canes.	As the boring starts from underground and the ravages are invisible until the cane is cut,—no satisfactory method of getting at caterpillar is known.
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Leaves and roots ...	Frog hopper—Tomaspis postica...	Adults attack leaves, piercing them with their beaks and sucking the sap. Young nymphs or larvæ attack the young roots, feeding on the sap, the latter cover themselves with a froth or spittle as a protection. This spittle contains potash.		Attract and destroy adults by means of trap lights. Apply quick lime to stools and earth up freely, this will bury existing nymphs and encourage the plant to throw out fresh rootlets.
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Section XI.—PLANT DISEASES.—*Continued.*

Ammoniacal Solution of Copper Carbonate.

Water	45 gallons.
Strong solution of ammonia	3 pints.
Copper carbonate	5 ounces.

The copper carbonate is made into a thin paste by adding a pint and a half of water. The ammonia water is then slowly added until a deep blue solution is obtained which is made up with water to 45 gallons.

Lime-Sulphur Wash.

[United States Department Agriculture.] Circular No. 1, Bureau of Plant Industry.

The mixture is composed of 10 lb. of flowers of sulphur and 15 lb. of fresh quick lime to 50 gallons of water. The lime should be put in a 50-gallon tub and 2 to 3 gallons of boiling water poured over it; the sulphur should be immediately added and another pail-full of hot water. The heat from the slaking lime will cause the mixture to boil violently for several minutes; some stirring is necessary and more water should be added if it gets too thick to stir. A piece of sacking may be thrown over the tub to keep in the heat. The boiling will continue for 20 to 30 minutes,* and when it ceases cold water should be added to make up the mixture to 50 gallons, the whole being thoroughly stirred and then strained through a sieve. All the sulphur should be carefully worked through the meshes.

Lead Arsenate.

Lighter than Paris Green and can be used with greater freedom, as it is insoluble in water and does not injure the foliage. Can be dusted on as a powder mixed with about 20 parts of slaked lime or wood ashes.

As a spray it is best applied at about a strength of 2 lbs. to a 100 gallons of water. It may however be used stronger without injury to the plant.

Preparation.

The powder is mixed into a thin paste with water, all lumps being carefully pulverised. Water is then added to make 100 gallons.

70.—Notes.

Among inquiries for assistance in the treatment of Plant Diseases are the following:—

- Coconut diseases at Laventille.
- Cane Blight and Frog hoppers.
- Caterpillars on citrus trees, (Papilio anchisiades, Esp.)
- Mealy bugs on cacao, (Dactylopius sp.)
- Caterpillars on vegetables, (no specimens sent).
- Thrips on Cacao.
- Carpenter bird injury to Cacao pods.
- *Aleurodicus* or White Fly on cacao in Tobago.
- Black scale on Castilloa rubber in Tobago.
- Mealy bugs on Cacao in Tobago.

*If the lime does not appear to have properly combined with the sulphur, the mixture should be boiled over a fire for about half an hour and then made up to 50 gallons.

Section XI.—PLANT DISEASES.—*Continued.*

Circulars have been issued on the Carpenter Bird, Thrips and Coconut beetle (Rhina barbirostris) and the Castnia licus moth. The two latter are reported to have been observed to attack the growing shoot of the Coconut Palm, and may possibly be connected with the disease known as Bud rot.

Mr. T. Thornton (Tobago) reported the discovery by him of a parasitic fly on Cotton worms. The Board's Entomologist reports it to be a Tachina —a good and useful parasite. This discovery may prove of considerable value to Cotton Growers.

The Board's Entomologist is continuing his observations on insects attacking the bud of the Coconut palm, the Castnia licus moth, and Frog-hoppers. The latter are reported numerous (February) in a field of Para grass, and again associated with root fungus in abundance.

There appears to be an impression among some Planters that a disease or a pest must be accurately identified before remedial treatment can be employed. Identification is valuable, but usually takes some time during which injury may be progressing rapidly.

For this reason it is useful to divide insects into the two easily recognised classes which are found to be most destructive, viz. :—

Biting ; Sucking.

Biting insects are killed by spreading poison on their food, and arsenate of lead is now more in favour for this purpose than Paris green.

Sucking insects are killed by spraying their bodies by some substances that have been found to be destructive to them. Of these substances, kerosene emulsion, lime-sulphur and resin washes are in common use.

For fungi generally Bordeaux mixture is used.

There should be no unnecessary delay in taking action with the bes available treatment, repeated in some cases ; and at the same time taking whatever preventive measures suggest themselves as most useful.

Special treatment is required for boring insects and those that live underground. They are among the most difficult to deal with.

Section XII.—ENTOMOLOGICAL.

71.—The Cane Sucker.

(*Castnia licus*, Drury, 1773.)

F. W. Urich.

At the end of last year in the course of investigations in connection with the Frog-hopper attack on Sugar canes it was found by Mr. A. E. Collens that a large percentage of stools in one of the districts was affected by the caterpillar of this moth. The cause of the sudden increase of this pest is a matter for future study and enquiry, but in the mean time the following notes will serve to call attention to an insect, which if left alone may cause further and more serious damage, especially as it appears to attack Banana as well as Coconut cultivations.

In one district from November, 1908, to February 15th, 1909, over 25,000 moths were caught. Like all members of the order Lepidoptera the damage is done by the caterpillar. In this family the caterpillars tunnel in the canes and in the course of their development hollow it out.

According to Kirby the Genus *Castnia* is widely distributed throughout the warmer parts of America from Mexico to Chili. There are now nearly 100 species known, differing very much in size, colour and even in shape, clothing and neuration (veining) of wings. Few of the species measure much less than 2 inches across the wings and the larger species expand as much as 7 or 8 inches. Many exhibit strong metallic reflections. *Castnia licus* or Cane-sucker is one of the commonest species throughout South and Central America. Although a moth according to classification

Section XII.—ENTOMOLOGICAL.—*Continued.*

the cane-sucker is of diurnal habits frequenting shady banana and cocoa cultivations and settling by preference on dry leaves. The cane-sucker is known to be a serious pest in other places, although it is its first recognized appearance in Trinidad as an injurious insect. Under date of 28th November, 1904, (*see Bulletin* U S. Department of Agriculture Bureau of Entomology No. 54, p. 72.) Mr. B. Howell Jones reports serious damage to cane fields in Demerara and mentions that a few children with nets had caught upward of a thousand moths in a week. The attack was then confined to one estate. In February, 1905, Mr. Jones gave the additional information that the plague of these insects still continued and that many thousands of moths were being caught weekly.

Mr. August Kappler, a Surinam Planter, refers to *Castnia daedalus* (an allied species) as being conspicuous by the damage its caterpillar does to the coconut palm. The female, he says lays her eggs singly on the lower leaves of a coconut tree and not more than 6–7 on one tree, the caterpillar bores through the bark and penetrates into the soft tissues; after a time the lower leaves turn yellow and hang down perpendicularly without dropping off. The caterpillar is removed from its burrow with a pair of pointed forceps and if the wound so caused is treated with tar the tree would recover, but the fruit for that year would be lost. When, however the growing point turns yellow, Kappler says that there is no recovery possible and the tree generally dies. In less than 2 years he lost 20 of his best coconut trees.*

In 1893 in the February number of the Journal of the Trinidad Field Naturalist Club, Mr. Thomas I. Potter, F.Z.S. mentions that he found the cane-sucker attacking Banana plants at St. Ann's, but at that time the damage was not extensive.

In 1907 in a Report on Banana disease at *St. Augustine* estate, Mr. A. E. Collens, F.C.S., says with reference to the Cane Sucker: "Two "almost full grown larvæ of this moth were obtained, one on a portion of "stem lying on the ground, which had been cut about six weeks before, "the other on a young plant. In the first instance the larvæ had burrowed "to the centre and was feeding on the fruit stem, in the latter it had "entered the stem near the ground and burrowed upwards from about an "inch in depth, for several feet. The damage could easily be followed "externally by a copious exudation of vegetable pectin from the plant "wherever the larva had tunneled to the surface."

Mr. Ottier has found caterpillars of this moth attacking young coconut palms at Laventille and Mr. Collens discovered a caterpillar feeding on the soft internal leaf tissue of a Palm (*Oreodoxa oleracea*) from the Cascade Valley.

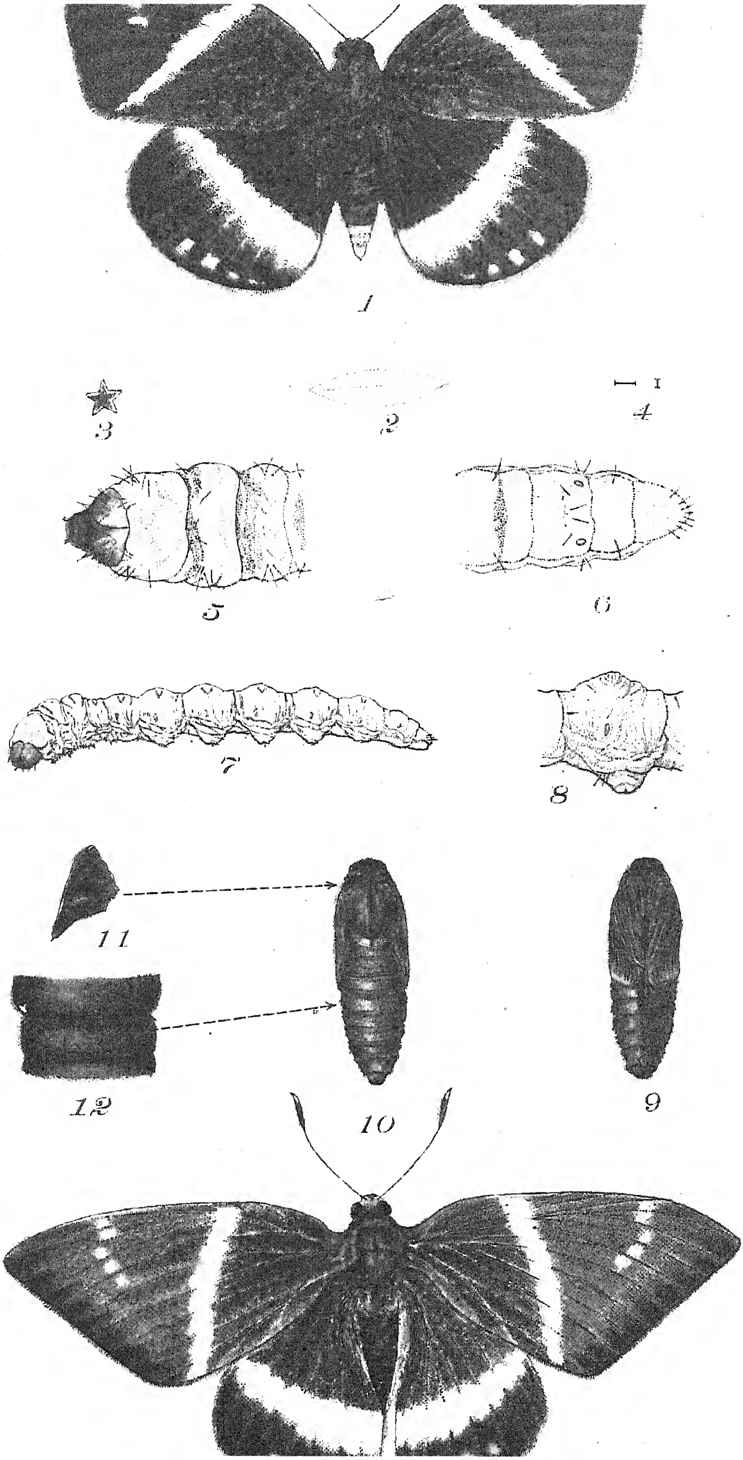
The life history has not yet been completely worked out, but the following notes may serve to supplement the illustrations :—

Egg (Figs. 2, 3 & 4). The egg is pinkish and has five longitudinal ribs (unfortunately they do not show well in fig. 2) which in cross section take the form of a star. After the young caterpillars have escaped from the egg the empty shell is grey almost white. According to Mr. Collens who kindly supplied some notes, the eggs are laid singly. A female moth under observation laid 50 eggs, 35 in two days and 15 on the third. According to Mr. Potter a female moth selected the base of a banana sucker for egg laying. In the field I have seen as many as four eggs at the base of cane plants.

Caterpillar. (Figs. 5, 6, 7, 8.) The caterpillars might easily be mistaken for the larvæ of beetles, but can be distinguished at a glance by observing the four prolegs one of which is shown enlarged in fig. 8, in beetle larvæ these legs are absent. The caterpillars vary in length from $2\frac{1}{2}$ to 3 inches. They appear to enter the cane from the base and eat their way upwards to about 12 or 18 inches from the ground filling their burrows with excrement and cane chips. When full grown they appear to remain more in the root stocks of the cane.

Pupa. (Figs. 10 & 9.) The pupa is formed in the caterpillars burrow generally low down near or under the ground among the roots of the cane plant. When ready to enter the pupal state the caterpillar with the help of silken threads and the chips

* The total number of trees is not given.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in the tunnel envelopes itself in a cocoon in which it undergoes its transformation. When ready to emerge as a perfect insect it works its way out of the tunnel to the surface of the ground by means of the spines shown in fig. 12. According to Mr. Collens a pupa under observation took 49 days to emerge as a perfect insect.

Adults. (Figs. 1 & 1A.) When just out from the pupa adults would appear as on the plate, but after flying about the cane and banana fields, their appearance would change through the loss of scales which in this genus come off very easily but the two types figured are the ones generally met with in Trinidad.

Further studies of the life history of this insect are necessary before definite suggestions for control can be made but up to the present the best course that can be recommended for sugar estates is to catch the adult moths; and grind or burn the canes in the fields most affected. The caterpillars have not up to now made themselves severely felt in Coconut and Banana cultivation, but when observed they should always be destroyed by extraction from the burrow or injection into it of a small quantity of bisulphide of carbon. The subsequent tarring of the tunnel or wound made should never be omitted, as it prevents the entrance of fungus spores. Another precaution that might be taken is the firing of all abandoned sugar or banana estates which provide suitable breeding grounds for these moths. So far no parasites of either caterpillar or egg have been observed.

72.—Insects and Insects destroying Fungi recently identified.

A. E. Collens.

Specimens of Frog-hoppers, and also some covered with a green mould were recently sent to the Bureau of Entomology, Washington, D.C., to be identified. These have been determined as *Tomaspis postica*, Walker, and the Fungi on them as *Oospora destructor* and *Penicillium anisotliæ*, commonly known as the green muscardine disease.

Among other specimens sent were guava flies, galls on cassava leaves, and a caterpillar infested with ichneumon parasites.

The guava flies were hatched from the worms so commonly met with here in ripe guavas. The flies are of a yellow colour with black or yellow stripes on the thorax, and wavy brown markings on the wings, the latter are twisted at a peculiar angle being, when the insect is in repose, almost at right angles to the usual position of an insect's wings. The species with the black stripe on the thorax has been determined as *Anastrepha striata*, Schiner, and the one with the yellowish stripes on the thorax as *Anastrepha acidusa*, Walker.

The eggs are probably laid on the young guava after the flower petals have fallen, and the grub pupates in the overripe fruit that have fallen to the ground.

One of the best methods of keeping them in check would be to gather up all the fallen fruit and either feed them to pigs, etc., or bury them. At present they are allowed to remain on the ground and fresh broods hatch out ready to deposit their eggs in the next crop. As all flies are extremely fond of sweet liquids, a possible means of destruction would be to spray the guava leaves with a solution of treacle or honey poisoned with Lead Arsenate; this however, can only be done if there are no bee-hives in the neighbourhood.

As an alternative spray the expressed juice of ripe pine apples or guavas might be used slightly sweetened and diluted. In Cape Colony the following mixture sprayed slightly on the foliage of the trees has been found to be very effective in poisoning fruit flies:—

Lead Arsenate	1 pound.
Treacle	18 pounds.
Water	25 gallons,

and it was proved that this mixture could be used with safety, provided the trees had passed the blossoming period.

Section XII.—ENTOMOLOGICAL.—*Continued.*

The galls on the cassava leaves were caused by a species of *Cecidomyia*, a small fly or gall midge, several minute hymenopterous parasites determined as Tetrastichus, sp., also hatched out of these.

The caterpillar forwarded was obtained from sugar cane plants in the Caroni district. It feeds on the young leaves of the cane, remaining concealed in the day time. Several were kept for identification but none hatched out. One pupated but had been already attacked by a parasitic Tachina fly, which emerged at a later date. The remainder succumbed to Braconid parasites (closely related to the ichneumon flies) no less than 50 emerging from one unfortunate caterpillar. These latter were identified as *Apanteles sp.*

It is by natural enemies like these latter that many injurious insects are kept in check and the possible extent of their damage greatly reduced.

73.—Inquiries about Insect Pests.

In connection with inquiries about insect pests, Planters and others when sending specimens can greatly expedite the work connected with the inquiry by observing the following directions:—

1. A letter should always accompany the specimens giving a short account of the observed habits and the extent of injury done by the insects.
2. All packages should be plainly marked with the name and address of the sender.
3. Specimens of the insect, its work, and of plants injured should be sent.
4. Caterpillars, grubs, maggots, and any other larvæ should be sent alive with a supply of food.
5. For packing caterpillars use wooden boxes for long distances, and tin boxes when the journey is not very long.
6. When in doubt about the manner of killing or packing any specimens write to the Department for detailed instructions.
7. All packages will be forwarded post free if addressed to "The Director, Department of Agriculture, Port-of-Spain."

Section XIII.—LIVE STOCK AND POULTRY.

74.—Strongylus.

The Department is at present collecting information as to the extent to which the Strongylus worm occurs among cattle in the colony, and as to its probable origin. Specimens of the parasite can be seen at the Central Office.

75.—Cattle Rearing.

The Wardens' Reports show that the *total* number of Oxen and Milch Cows in the Colony is but very slightly in excess of the number *annually* imported from Venezuela.

This is a matter requiring serious attention. Apart altogether from the possibility—which at present seems remote—of supplying butchers' meat, there is the question of much-needed organic manure on cacao estates. For this, every estate should maintain a number of cattle in proportion to the number of trees, and the manure from the pens should be regarded as a necessary part of the cultivation. Wherever guinea-grass or para grass can be grown three acres should furnish a large part of the food supply for ten head of cattle. The manure obtained would help to restore the diminishing amount of organic matter, and would aid in the development of nitrogen producing bacteria which is an essential feature in modern methods of cultivation. At the same time meat production goes on, and although the price of 5 cents per lb. live weight may not be directly remunerative, it should be indirectly so. The absence of stock rearing is a very noticeable drawback in agricultural practice in Trinidad.

Section XIII.—LIVE STOCK AND POULTRY.—*Continued.*

76.—Government Farm.—Statement of Foodstuffs used.

Animals Fed.	Number Fed.	Total Daily.	Oil Meal.	Stock Food.	Linseed Meal.	Cotton Seed Meal.	Coconut Meal.	Rice Meal.	Rice.	Pease.	Oats.	Corn.	Molasses.	Salt.	Per head.	Cost per head.	Cost per day.	Cost per annum.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	c.	$ c.	$ c.
Milking Cows	80	348	...	...	1	·75	1	1	...	...	...	...	·50	·10	4·35	5·10	4 08	1,489 20
Young Calves	55	133	·50	·75	...	...	...	·75	...	...	...	...	·33	·10	2·43	3·50	1 92·50	702 62
Old Calves	65	83	·25	·36	...	...	...	·36	...	...	...	...	·21	·10	1·28	1·76	1 14·40	416 96
Heifers	50	35	...	...	·16	·12	·16	·16	...	...	...	...	...	·10	·70	0·80	40	146 00
Steers and Young Bulls... ...	40	104	...	...	·66	·52	·66	·66	...	...	...	...	...	·10	2·60	3·17	1 26·80	462 82
Working Oxen	9	31	...	...	·90	·63	·90	·90	...	...	...	...	...	·10	3·43	4·20	37·80	137 97
Bull (Red Poll)	1	5	..	...	...	...	...	...	...	...	5	...	...	·10	5·10	10·55	10·55	38 50
Mules and Horses	11	78	...	...	...	...	...	...	...	...	2·50	2·50	...	·10	7·10	9·67	1 06·37	388 45
Brood Mares	8	46	...	...	...	...	2	3·62	...	...	...	...	...	·10	5·72	6·67	53·36	194 76
Young Mules and Horses ...	4	25	...	...	...	...	2·20	4·05	...	...	...	...	...	·10	6·35	7·40	29·60	108 04
Boars	3	15	...	...	...	...	2	...	...	...	...	3	...	...	5	8·25	24·75	90 33
Brood Sows	12	60	...	...	...	...	5	...	...	...	...	...	...	...	5	7·50	90	328 50
With young 1-5 months ...	55	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Poultry	167	24	...	...	..	...	...	...	*3	*2	*4	*15	...	...	·14	·31	52·65	192 17
																	$12 86·78	$4,696 33

* lb, total daily.

12th March, 1909.

(Sgd.) JOHN McINROY,
Acting Manager, Government Farm.

Section XIV.—AGRICULTURAL INSTRUCTION.

77.—Agricultural Instructors and Inspectors.

It has been decided to place the present Agricultural Instructors under the control of the Education Department. The Board of Agriculture will appoint Inspectors who will combine the duties of inspection of plant diseases with Agricultural instruction in the field.

78.—Winners of the Carmody Prizes.

The Teachers who made the best general exhibits at the recent Agricultural Shows, and who were in consequence awarded the Carmody Prizes for excellence are:

Port-of-Spain	centre:	J. J. Beard, Carenage Government School.
San Fernando	,,	A. Bonas, Marabella R. C.
Princes Town	,,	W. F. Harewood, Princes Town Wesleyan.
Arima	,,	Sydney Smith, Arouca Government School.
Tobago	,,	L. B. Hilaire, Toco R. C.

Section XV.—MISCELLANEOUS.

79.—Statistics. (Wardens' Reports, 1907-8).

The absence of reliable statistics as to acreage under cultivation and actual yield are great drawbacks to an agricultural colony. The only statistics we possess, that can be relied on, are those of produce exported; but though in some instances these include the greater part of the Colony's production, in others it is not so. Notable examples are coconut oil, sugar, rum, and molasses—large quantities of these being consumed locally. In the case of Rum, the quantities consumed locally are shown in the Receiver-General's returns.

The recent returns by the Wardens are a great improvement on previous ones, and if continued carefully along similar lines are likely to become reliable and proportionally valuable.

From these returns we abstract the following figures of cultivated lands:—

Acres in Estate Canes ...	47,070
,, ,, Farmers ,,	18,575
,, ,, Cacao	245,706
,, ,, Coconuts	10,743
,, ,, Rice ...	9,522
,, ,, Rubber	2,960
,, ,, Limes	497
,, ,, Oranges	388
,, ,, Pine Apples	25
,, ,, Provisions	32,938
,, ,, Good Forest land	317,666

The following are the figures for Produce:—

Sugar ...	50,290 tons.
Cacao ...	55,804,858 lbs.
Coconuts	17,840,542 No.
Copra ...	1,445,017 lbs.
Rice ...	10,531,120 lbs.
Limes ...	6,289 brls,
Oranges	603,200 No.
Plantains	303,100 ,,
Pine Apples ...	11,400 ,,
Ground Provisions	4,305,616 lbs.
Tobacco	5,075 ,,

The figures for Stock are:—

Horses...	4,023 No.
Oxen ...	4,974 ,,
Milch Cows	5,429 ,,
Mules ...	3,612 ,,
Donkeys	4,329 ,,
Pigs ...	8,346 ,,
Goats ...	6,451 ,,
Sheep ...	2,502 ,,

The reports contain many valuable suggestions which are deserving of careful consideration.

Section XV.—MISCELLANEOUS.—*Continued.*

80.—Drainage.

W. E. Broadway.

Although so much has been written, talked about, and discussed over the subject of draining land from time to time, yet it seems really advisable to continue impressing upon many people engaged in cultivation that it is a matter of the very greatest importance to ensure the desired object in view, namely, ample returns from the crops that occupy their land. In many instances one is apt to overlook the fact that defective drainage causes plants to put on an unhealthy appearance and, thus comes about the idea that resort to spraying with insecticide is necessary to revive the tree and bring it back to its former condition. It is hardly necessary to point out that such a process can never meet with a planter's satisfaction. Land is often blamed in not returning the right balance to the planter's pocket when, all the time, it is not the fault of the soil, but the blame can reasonably be laid at the door of the cultivator. Within limits one can never drain too well where "sticky" or adhesive land exists, whether it be on slopes or flat positions. Take the cacao tree as an instance. It may be that appearances are all that can be desired but, as it grows older, an undesirable yellowness and stuntedness of leaf and branch growths sets in. This is proof that something is wrong. Frequently in cacao lands this is *solely* attributable to want of *deeper* drains so as to allow the sourness of the sub-soil to filter out instead of to the attack of any disease whatever of stem, branch, leaf and pod as *the first cause.* Without a sound system of this vital item in cultivations no amount of manures and spraying will produce the returns that a planter looks for.

That this defect is present in our midst only needs a little observation as one travels through districts. I look to the soil, as of course others do, in the light that it is the very foundation of a plant's health, and since that is the case, it becomes essential on the part of us all to see, that above all things, our drainage plans are being carried out in a thorough and an effective manner. Vigorous, healthy roots mean thrifty branches and leaves; roots no more like sour and acid substances, or liquids, than the parts above ground like objectionable environments; without the former conditions prevailing, the latter cannot be maintained satisfactorily.

81.—Notes on the climate of Tobago.

Statistics are generally dry reading, but any information about climate is of importance to an intending settler and especially to any one taking up Cacao planting.

As in most Tropical Countries the year is divided into a dry and a wet season. The former is from January to May inclusive, the remainder of the year is the wet season, but occasionally about October there is experienced a fortnight or three weeks of comparatively dry weather, called the "Indian Summer." For about ten months in the year there are trade winds which make life a pleasure. In August and September, or sometimes September and October there is less breeze and this is the hottest time of the year. At the Observation Station, 400 feet above Sea level where these notes have been compiled, the highest temperature recorded in five years has been 86° and the lowest 69° (Fah.).

If a resident takes care that no wild plantains, or travellers palms or stagnant pools are allowed near his dwelling, where mosquitoes can breed, he need have no fear of malarial fever. The writer has resided 6 years in Tobago, never uses a mosquito net, has never had any fever, and enjoys as good health as in the old country.

A matter of great importance to a Planter is that Tobago is outside the hurricane zone. There has been no "blow" to injure trees since 1847 and that could not have been of exceptional severity, as trees of older date are still standing in exposed places.

Section XV.—MISCELLANEOUS.—*Continued.*

The observations on Rainfall apply to the Windward District which is best suited to the Cultivation of Cacao and Rubber. The Leeward Rainfall is less by about 30 inches, but it promises as well for the cultivation of Cotton and Coconuts as the Windward for Cacao and Rubber.

One cannot but observe in the following analysis of Rainfall at this Windward station, two most important points for Cacao Planters, 1st. the fine distribution of rain throughout the year, and 2nd, the absence of dry spells :—

RAINFALL IN EACH MONTH FOR FIVE YEARS.

	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Days on which rain fell.
904 ...	5·71	3·29	12·22	4·44	3·19	10·06	11·52	8·52	8·27	7·44	11·88	7·93	94.47	279
1905 ...	3·19	2·70	4·02	7·15	5·55	7·93	10·91	22·01	7·87	6·81	11·11	9·81	99·06	284
1906 ...	3·38	3·91	2·45	2·30	7·67	12·49	13·62	12·46	6·93	12·94	11·53	12·22	101·90	255
1907 ...	8·05	4·87	3·58	1·53	7·37	7·98	12·40	9·68	9·90	6·82	9·09	8·36	89·63	290
1908 ...	4·22	1·76	5·62	2·53	9·59	8·87	12·05	8·04	9.40	9·54	7·62	12·26	87·50	290
Average	4·91	3·30	5·57	3·59	6·67	9·44	12·10	12·14	8·47	8·71	9·44	10·11	94·51	279

Smallest number of days in any month on which rain fell ... ... 13 days.

The only excessive rainfall was in August, 1905, when 8 inches fell in ten hours. In the dry season—January to May—more rain falls through the night by about 5%. This is reversed in the wet season—June to December—when about 20% more rain falls during the day.

The result of the absence of dry spells and the good distribution of rain is that Cacao trees crop all the year round. The main crop is during November—December, and a lesser crop April to June, but the trees are never without some fruit.

Roxburgh, Tobago, 2nd Jany., 1909.

82.—Colvillea racemosa in Tobago.

W. E. BROADWAY.

As records are always valuable it is advisable to note that this rare tree is fruiting freely at the back of the Government Buildings in Scarborough, Tobago.

Seeds are being collected for propagation as well as for distribution. It would be interesting to know its history. Who planted it, and where did this particular one come from ?

83.—Shelter belt at the Tobago Botanic Station.

W. E. BROADWAY.

There is a fine wide line of young trees which were planted a few years ago by the former Curator (the late Mr. H. Millen) in an exposed position made up of five distinct kinds of trees, Mango, Mahogany, Galba, Star apple and *Thevetia neriifolia.* As it now stands, it is a barrier to the high winds which frequently sweep across that part of the grounds and consequently, accomplishes the purpose it was intended for as a successful windbreak. Tobago planters might inspect it to their advantage.

Section XV.—MISCELLANEOUS.—*Continued.*

84.—Second Note on the Marbela Manjak Mine.

By R. J. Lechmere Guppy.

Having been favoured by James Wilson, Esquire, of Messrs. Goodwille and Wilson, with samples of the rocks found in the Marbela Manjak Mine, I was enabled to present a short preliminary note on the subject published in the Proceedings of the Victoria Institute, 1904, and in the Geological Magazine, London, 1904, page 276.

The receipt of additional samples of the rocks, the last of which came through L. J. Bernstein, Esquire, induces me to modify my opinion on some points, and I therefore contribute a second note on the subject.

Down to a depth of about forty or fifty feet the material obtained in sinking the mine is mostly of a heterogeneous character, showing extensive disintegration and disturbance due partly to pluvial and weathering agencies and partly to human interference. Below that we have indurated clays and sandstones containing gypsum, and it is in these and the subjacent strata that the manjak occurs in veins and seams. These continue down to about 160 feet, and were apparently laid down in an area where tide-water and flood-water were alternately admitted. These deposits are extremely fine grained and the clastic matter in them is mostly very fine sand with a large proportion of argillaceous matter, showing that its origin was at a considerable distance. But below this the fluviomarine character gives place to a decidedly marine one, though the proportion of calcareous matter is still much less than in the typical Naparima rocks. These rocks show the gradual shoaling of the water by matter brought down by the rivers from the neighbouring continent. The foraminiferal fauna which in the lower beds is of an entirely deep sea character becomes gradually driven out, and only those species remain which are capable of existing under estuarine or fluviomarine conditions.

The following is a List of the Foraminifera from the deposits below 160 feet in vertical depth :—

Spiroloculina limbata.
  robusta.
Chilostomela ovoidea.
Webina clavata.
Trochamina proteus.
Amodiscus tenuis.
  incertus.
Cornuspira polygyra.
Cyclamina cancelata.
  pusila.
Reophax nodulosa.
Haplophragmium neocomianum.
  foliaceum.
Clavulina eocaena.
Bigenerina nodosaria.
Spiroplecta biformis.
Bolivina beyrichii.
Nodosaria comata.
  soluta.
  raphanistrum.
Glandulina laevigata.
Cristelaria limbata.
  echinata.
  crepidula.
  clypeata.
  italica.
Frondicularia inaequalis.
  striata.
  mucronata.
Uvigerina pygmaea.
Polymorphina comunis.
Bulimina pyrula.
Globigerina buloides.
Truncatulina praecincta.

Section XV.—MISCELLANEOUS.—*Continued.*

Textularia gramen.
trochus.
Ellipsoidina subnodosa.
Lagena formosa.
orbigniana.
haidingeri.
ariminensis.
Pulvinulina pauperata.
elegans.
Rotalia soldanii.

(This List is only a preliminary one.)

I have no evidence as to the dip of the strata in the Marbela Mine, except that it is high and variable. The strike is approximately S.W. to N.E.

The sample referred to as having been furnished to me by Mr. Bernstein, came from a depth of about 200 feet. It was a moderately hard very fine-grained sandstone—a sandy Mudrock in fact; black in color with some argillaceous matter in it, and some larger fragments of stone, one or two of which were 6–7 mm. in diameter. The black color seems to be due to carbonaceous matter which is very small in quantity and probably infiltrated from adjoining beds. This rock contained a considerable number of Orbitoides, similar to those found in the lowest beds of the Naparima Tertiaries. They show that the Orbitoides-bed underlies this series of strata and that the base of the tertiaries has been reached. This bed appears again near the San Fernando Railway Station and at Point Bontour, also at Ali Creek.

The Orbitoides are almost exactly the same as those figured by Brady from Sumatra (Geol. Mag. 1875, Pl. XIV., Figs. 2 and 3), and may for the present be called *O. dispansa*, Sow., though I could not assert the specific distinctness of the specimens placed under that name, and I should prefer to adhere to my former treatment of the nomenclature as recorded in the Journal of the Geological Society, 1892, page 532. Silvestri has referred the Form called *O. dispansa* to *Lepidocyclina marginata* Micheloti in a Paper in Atti Acad., romana 1906. (*See* also Silvestri "Sulla Orbitoides gumbelii" in Atti Acad. romana Dec. 1905, page 34). The superficial characters of our Form are similar to those illustrated by Silvestri. Among the Marbela specimens we may roughly distinguish three Forms; 1° the small or young forms, nearly smooth; 2° the medium-sized forms, having a pitted or foveate surface; these are much thinner towards the edges than the third form in which the superficial cells are converted into tubercles owing to the development of exogeneous deposit. This which may be called the adult form is almost evenly biconvex. In the small form the process of shell construction is going on, the sarcode body forming cells on a definite cyclical plan for its reception. Having attained its full growth the extension of the sarcode body is lodged in cells constructed for its accommodation on the outer surface of the disk, forming the pitted or foveolate structure of that surface. The organism growing older but still retaining some of its power of secreting calcareous matter gradually covers over or fills up these superficial cells with exogeneous deposit forming the lumps or tubercles seen in old specimens.

The Orbitoides found at Point Bontour where I originally discovered the Orbitoides-bed are easily cut across whereby the internal arrangement of the chambers is seen. But the Marbela

Section XV.—MISCELLANEOUS.—*Continued.*

specimens are so infiltrated with mineral matter that the internal structure is obscured. Nevertheless enough is seen to make their relationships tolerably certain.

We originally obtained the names of *Orbitoides mantelii* and the other varieties found in Trinidad, &c., and recorded in my Paper in the Geological Society's Journal, and elsewhere, from T. Rupert Jones, who published a Paper on the Orbitoides from Jamaica in the same Journal in 1863, page 514, and again in the Geological Magazine, 1864, page 103. It was from this last rather than the first-named Paper that we got the names above-mentioned, for in my Paper of 1863, read to the Scientific Association, and re-published in the "Geologist," 1864, page 159, I did not venture to use specific names. Speaking of the Antiguan Orbitoides, Rupert Jones says: "This large thin Orbitoides is of considerable interest it belongs to that species of Orbitoides which is characterized by having vertical partitions to its central layer of chambers, and these more or less cylindrical, namely, *O. mantelli.* It is the exact counterpart of the Orbitoides I have lately observed in the limestone from Malta." He further states that he found the same variety of *O. mantelii* in the Jamaican limestone mixed with *O. dispansa* and *O. fortisii.* Dall, (Proc. U.S.N. Museum, 1896, page 329), observes that in no case which he has examined has the West Indian species proved to be the true *O. mantelii.* Upon this Hill remarks (Geology of Jamaica, page 144): "It is now apparent that Dall's recent statement * * * to the effect that *Orbitoides mantelli* has not been found in the West Indian species is incorrect, and we must accept the occurrence of this species as identified by the eminent authorities T. Rupert Jones and R. M. Bagg." The variation in Orbitoides leads me to believe that the different forms found in the Trinidad and other West Indian rocks are all really of one species. I cannot see any true and constant differences between our fossils and those figured by Brady and Silvestri in the places quoted, and by Carpenter (Introd. Pl. XX). In these circumstances I do not feel competent to make any change in the nomenclature, and to avoid confusion I leave matters in this respect as they were before. Hill's observation that Orbitoides are not found above the Eocene is, in my opinion fully borne out by the facts here as well as in Jamaica.

I consider that the rocks occurring in the Marbela Mine down to the depth of 160 feet represent the Nariva series, while the lower beds represent the Naparima oceanic deposits. These last differ in some respects from the Naparima oceanic beds, and the difference may be due to the deposition of the sediments in a shallower sea on the flanks of the cretaceous ridge crossing the middle of the Island and lying to the north of the great Naparima Anticline. In my first note already quoted I described the difference in these words: 'A very noticeable difference is that the material of the oceanic beds when washed yields a residue consisting almost entirely of Foraminifera (chiefly globigerina), while that of the Marbela deposit consists of small pieces of slaty-looking and ferruginous materials, the foraminiferal fauna being much scantier than that of the oceanic beds." While admitting a large amount of variation in composition in the

Naparima rocks, this may be held to be true generally of the oceanic beds. We have to assume therefore a shallower sea and a greater quantity of muddy sediment in this area than in that to the south of Naparima Hill (*See* my Section in Journal of the Geological Society, 1892, p. 522).

From Mr. Wilson I received some additional samples of a hard sandstone which appear to have come from a lower depth than the Orbitoides bed, some 220 feet deep These contain fossils but not in a determinable condition, and the rock is so hard that there is no means of extracting them. I believe, however, that these rocks are the very base of the tertiaries or top of the cretaceous. I consider therefore, that the rocks at the Marbela Mine represent the equivalent in time of the whole Naparima series and extend downwards from the Miocene inclusive to the Eocene and top of the cretaceous. They were however deposited in a shallower sea than the true oceanic beds and one wherein the conditions varied somewhat from those.

During the cretaceous period the Amazonian and Orinocan region was occupied by sea as shown by Karsten (Geognostische Verhältnisse des westlichen Columbien), while at the same time a portion of the Atlantic Ocean was occupied by land. As explained in my papers ("Growth of Trinidad" and "Geological Connexions of the Caribean Region,") the sediments of which the rocks of Trinidad are composed were up to the end of the cretaceous period derived from the land which existed to the north and north-east. But upon the close of the cretaceous period and the gradual rise and filling up of the Amazonian and Orinocan region, the sediments now came from the west and south-west inaugurating the period of asphaltic and carbonaceous deposits which probably continued throughout the tertiary period.

The origin of the carbonaceous substances is to be found in the vast quantities of vegetable matter brought down by the rivers from the continent of South America. This matter being of a slightly greater specific gravity than water, is subject to the laws which govern the removal and deposition of sediment or clastic material. Now one of these laws is that material of like specific gravity and of like fineness or coarseness of grain or dimensions of the component parts is deposited together and apart from dissimilar materials. Hence the vegetable matter brought down by the rivers was deposited in layers banks or strata becoming interstratified with other sedimentary materials as the process of sedimentation and deposition went on. Chemical changes supervened which converted the vegetable tissues into the forms in which we now find them, namely Lignite, Asphalt, Manjak and Petroleum.

P.S.—Basing my opinion on the theory expounded above, I predicted two or three years ago that petroleum would be found in the deltas or sedimentary formations at the mouths of tropical rivers. The prediction has already been verified in the cases of Nigeria and Tampico.

Section XV.—MISCELLANEOUS.—*Continued.*

85.—Preliminary notice of a discovery of Fossils in the Tamana District, Trinidad.

By R. J. Lechmere Guppy.

Mr. P. W. Jarvis, of the Colonial Bank, has been kind enough to furnish me with some samples of fossiliferous rock from Machipur near Montserrat in the Tamana district. These samples are an indication of the richness of that locality in fossils, and no doubt many remarkable and interesting deposits will be found in the district. The present collection contains corals so highly altered by fossilization as to be scarcely determinable. They are like some of those described by P. M. Duncan from West Indian localities, and better specimens may hereafter be found admitting of specific determination. Most of the specimens are a coral limestone, and in the interstices of this is found a calcareous sandy deposit containing numerous foraminifera polyzoa and echinoderm remains, none of which are in a state for identification except one foraminifer, namely *Amphistegina,* and this occurs abundantly, but of small size. The most interesting fossil is a crab, of which I append a description. Among mollusks there is an olive and a concentrically-ribbed bivalve which might be a Venus, but the hinge and interior are not visible. A small imperfect bivalve seems to be a *Limea.*

Ranina cuspidata.—New Species.

The Carapace is rather evenly convex and the general contour is almost circular, antero-lateral angles being formed by four flattened acute spines pointing outwards beyond the general outline of the Carapace. These spinose projections are somewhat similar to the foliaceous expansions of *R. palmacea* from which they differ in pointing outwards instead of forwards. The median portion of the Carapace is formed by a round carina which is separated off by moderately deep grooves from the lateral portions, thus dividing the back into three parts, the median part bearing a single row of distant, low, but acuminate tubercles; and each lateral portion two rows of similar tubercles somewhat irregularly arranged. The length of the specimen is about 5 centimetres by 4½ centimetres in extreme width.

A specimen of *Ranina* collected by me from the Naparima rocks was described by my friend Dr. Henry Woodward, F.R.S., in 1866, under the name of *R. porifera,* (Jour. Geol. Soc , Vol. XXII, p 591.) Dr. Woodward gave a list of all the species of Ranina then known to him, eleven in number, of which ten were fossils from tertiary deposits, and the remaining one is a living species found in Japanese and Eastern seas. I am not aware of any additions having been made to Woodward's list. I am unable positively to allege that our present species is different from that described by Woodward, inasmuch as in the latter the superficial characters of the Carapace are preserved whereas in the present specimen the shell has disappeared. *R. porifera* also lacks the frontal margin so that we do not know what the form

of it was, while in *R. cuspidata* the frontal margin is almost perfect. Further, the dorsal surface of *R. porifera* is free from tubercles.

The occurrence of *Ranina* in the tertiary rocks of Trinidad is another fact to be added to those noticed in my Paper on the "Geological Connexions of the Caribean Region," showing the probable connexion by sea between the Caribean Sea and the Pacific Ocean at a former epoch.

The concentrically-ribbed bivalve referred to in the foregoing Paper is probably *Venus blandiana*, Guppy, (Proc S. A. Trin., 1873, page 85. Pl. II, F. 8; Geol. Mag. 1874, Pl. XVII, F. 8). It is said by Dall Florida Fossils, Part VI, page 1277) to be like his *Cytherea strigilina*, but I do not know that species. It is like *V. versatilis*, Dolt., Faluns of Touraine (Journ. Conch. 1888, Pl. XII. F. 4).

Explanation of the Plate.

Tertiary Fossils, Trinidad.

Fig. 1.—Ranina cuspidata —Machipur Tamana, Trinidad.

Figs. 2–3.—Orbitoides dispansus—Bontour Point, Naparima, Trinidad.

„ 4–6.—Orbitoides dispansus—Marbela Manjak Mine.

Extract from the Experiment Station Record U. S. A.

86.—America's amazing agricultural advance.

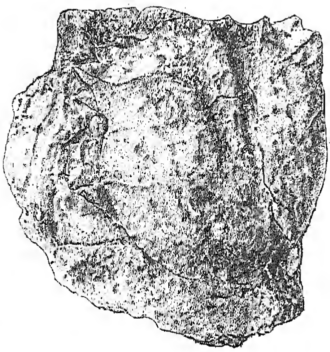
Statistics of agricultural wealth production, value of farm property, and of population engaged in agriculture during the years 1870 to 1908, inclusive, are presented and discussed in this article.

The increase in value of farm products is shown by the statement that "in the 20-year period between 1870 and 1890 the gain was only $500,000,000; in the 30-year period between 1870 and 1900 the gain was only $2,800,000,000; whereas in the 8-year period from 1900 to 1908 the gain was $3,300,000,000, or $500,000,000 more than for the 30 years from 1870 to 1900." In 1907 the value of farm products raised was $7,412,000,000, the value of all farm property $28,077,000,000, and the number of people engaged in or dependent on agriculture 11,991,000. The great increase in wealth production is attributed to the rapid growth in scientific farming.

87.—Agricultural Research—Methods reviewed.

In a preface to a recent issue of the Experiment Station Record (U. S. A.) the Report of the Commission on Agricultural Research is Editorially reviewed; and the following paragraphs are reproduced here as they contain very valuable suggestions:—

"(1) The development of research effort has not been symmetrical and logical. Adequately trained men have not been provided in sufficient numbers to expend in the way of capable investigation the entire amounts of national and state appropriations that have been applied to agricultural research. This is one of the reasons why the more difficult agricultural problems have so largely remained untouched. . . .



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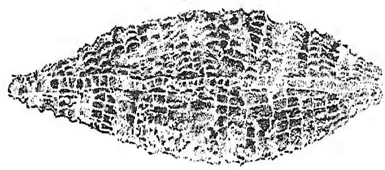

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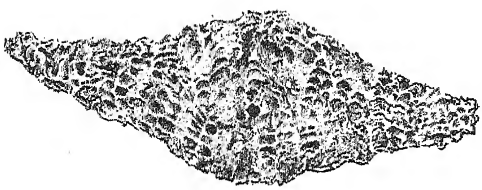

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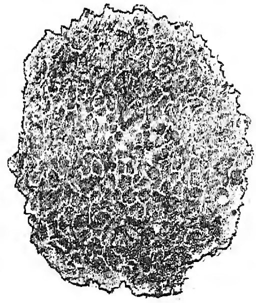

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1. Ranina Cuspidata. *2-6. Orbitoides Dispansa.*

Section XV.—MISCELLANEOUS.—*Continued.*

"(2.) Many persons nominally holding research positions have been investigators only in name, for their time and energy have been absorbed by other duties. . . .

"(3.) The persistent and widespread promotion of popular education and of public good will has unquestionably had a profound, and not always immediately healthful, influence on the extent and character of . . . . agricultural research. . . .

"(4.) The urgent and natural call for results that would produce an immediate and favourable reaction upon the public mind has not only brought about an era of the diffusion, rather than of the acquisition, of knowledge, but has, quite generally, led to the study of problems admitting of prompt conclusions, more particularly problems of a business character directly related to financial benefit, rather than those that are fundamental.

"(5.) As one result of the close association of scientific inquiry and popular education a true conception of real and efficient research has not been fully maintained in the minds of all those engaged in the work of agricultural investigation. The effect of such a situation upon the progress of agricultural knowledge is obvious."

Among the recommendations which in the judgment of the commission, "should guide in the promotion, organization, and prosecution of research in agriculture" and which are regarded "as essential to bringing about the conditions that all friends of agricultural progress desire to see established," are the following:—

"(1.) Every effort should be made to promote the training of competent investigators in agriculture both in the agricultural, and, so far as practicable, in the non-agricultural, colleges and universities, and their training should be as broad and severe as for any other field of research.

"(2.) The progress of agricultural knowledge now demands that agricultural research agencies shall deal as largely as possible with fundamental problems, confining attention to such as can be adequately studied with the means available.

"(3.) The work of research in agriculture should be differentiated as fully as practicable, both in the form of organization and in the relations of the individual investigator, from executive work, routine teaching, promotion, and propaganda, and should be under the immediate direction of an executive trained in the methods of science who should not be hampered by other duties of an entirely unlike character.

"(4.) The investigator should be free from all coercion whatever. In reaching his conclusions he should be equally free from the prescription of received opinion and the temptation to exploit his results for the purpose of obtaining future support.

"(5.) Any research agency charged with a single main line of investigation should be so organized that it may employ within itself all necessary processes in any branch of science. The co-operation of any or all of the departments of an Experiment Station on a single problem, when necessary, should be a fundamental requirement."

The report of the Standing Committee of the association on station organization and policy dealt with several of the matters discussed in the Commission's report, but in a somewhat more specific way. Like those of previous years, it was to a large extent based upon the concensus of opinion of station men as to the most practicable means of securing the highest efficiency in station work.

The report points out certain defects of administrative organization which still prevail to some extent and defines the functions of administration as related to research, as follows:—

"(*a*.) To help to determine in advance whether the proposed research is profitable and altogether advisable from the standpoint of the public, whose representative for the time being the administrative officer must be.

"(*b*.) To assist in determining what lines of experimentation are calculated to throw profitable light upon the problem.

"(*c*.) To help determine whether the work is best carried on by one individual representing a single line of inquiry or by two or more working in conjunction, and if the latter, to secure in advance a complete understanding as to mutual duties, rights, and responsibilities. Upon all these points the judgment and the point of view of the administrative officer is not only likely to be broader but certain to be freer from personal bias than is that of the professional investigator.

Section XV.—MISCELLANEOUS.—*Continued.*

"(*d.*) The experiment once decided upon, however, and funds provided, administration is over until results are due, when it begins again and does not cease till reports are published and circulated. The less administration during the progress of the work the better for all interests, and if the need of it becomes clear, it is the best of evidence that administration was remiss at the outset. Your Committee cannot too strongly point out the necessity of the entire freedom as to methods of investigation on the part of the staff worker who has been employed because of his expert knowledge of the matter and methods of work in a highly specialized field."

The ideal thus presented by the Committee is "administrative efficiency and sympathetic helpfulness without interference," requiring "for administrative officers men not only of good business methods and large outlook, but also with the highest obtainable training along some important line of science as related to agriculture."

The Committee favors an organization "strong enough to recognize the interest of the whole station as above those of any department or separate interest and strong enough to enable the entire influence of the whole body to be exerted in any desired direction on short notice."

As regards lack of permanency and continuity of work and resulting decreased efficiency, the Committee enumerates a number of causes, but is of the opinion "that the interference of teaching and extension work, and the payment of poor salaries, are among the prominent causes of unsatisfactory work and of frequent change."

The Committee "reaffirms the recommendation of last year to the effect that there should be concentration on a few lines of research, and further recommends that there be close adherence to a thoroughly considered, definite, and well-planned projects; that every effort be made to retain experienced and well-trained men; that an associate be appointed in each important department who shall be capable at any time of taking up the work of the chief; that the finances of the stations be so administered as to insure the supply of all suitable facilities for work; and that the integrity of long-established experimental fields should be maintained."—("Experiment Station Record"), December, 1908.

Section XV.—MISCELLANEOUS.—*Continued.*

Price List of the Economic Plants available for distribution at the Botanic Station, Tobago.

Fruits.

Scientific Names.	*Common Names.*	*Price per Plant from*
		Cents.
Achras sapota ...	... Sapodilla	4
Anona muricata ...	... Soursop	2
,, reticulata ...	... Custard Apple	2
,, squamosa ...	... Sugar ,, ...	2
Blighia sapida ...	... Akee	2
Citrus aurantium, var.	... Ruby Orange Budded... ...	12
,, ,,	... Navel ,, ,, ...	12
,, ,,	... King ,, ,, ...	12
,, ,,	... Jaffa ,, ,, ...	12
,, ,,	... St. Michael Orange Budded ...	12
,, ,,	... Sandford ,, ,, ...	12
,, ,,	... Pine Apple ,, ...	12
,, decumana ,,	... Shaddock ,, ...	12
,, ,, ,,	.. Grape Fruit ,, ...	12
,, medica, ,,	... Citron ,, ...	12
,, ,, ,, acida	... Spineless Lime ,, ...	12
,, ,, ,, ..	... Common ,, Seedling ...	2
Mangifera indica, ,,	... Malda Mango Grafted ...	25
,, ,, ,,	... President ,, ,, ...	25
,, ,, ,,	... D'Or ,, ,, ...	25
,, ,, ,,	... Rousseau ,, ,, ...	25
,, ,, ,,	... Millen ,, ,, ...	25
,, ,, ,,	... Gordon ,, ,, ...	25
Mimusops globosa	... Balata	2
Passiflora quadrangularis	... Granadilla	4
Psidium Cattleyanum	... Chinese Guava	2
,, guava, var.	... Large Red	2
Punica granatum ...	... Pomegranate	4
Spondias dulcis ...	... Golden Apple	4
Tamarindus indica ...	... Tamarind	2
Beverage Plants.		
Coffea Liberica ...	... Coffee	2
,, stenophylla ...	... ,, ...	2
Theobroma Cacao ...	... Cacao	1
Spices.		
Myristica fragrans ...	Nutmeg	4
Rubbers.		
Castilloa elastica ...	... Central American Rubber ...	2
Funtumia elastica ...	... West African or Silk Rubber ...	4
Manihot glaziovii ...	... Ceara Rubber	4
Mimusops globosa ...	... Balata	2
Drugs.		
Erythroxylon coca ...	Coca	2
Timbers.		
Guaiacum officinale ...	... Lignum vitæ	2
Mimusops globosa ...	... Balata	2
Shade and Decorative Trees.		
Casuarina muricata ...	... ...	2
Erythrina velutina ..	... Bocare	2
Parmentiera cerifera ...	... Candle Tree	2

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INDEX.—CONTINUED.

INDEX.—Continued.

BOARD OF AGRICULTURE.

RULES AND REGULATIONS.

THE Board shall meet on the 3rd Friday of every month, (but on the 2nd, or 4th Friday if the 3rd Friday occurs in the week preceding the departure of the English Mail) and at other times when required. Meetings—When to be held.

Except in cases of urgency not less than three clear days' notice of any meeting shall be given to each member together with the agenda paper. Notices of meetings.

Notices of motions should be sent to the Secretary at least one week before the meeting in order that they may be circulated before the meeting. Notices of motions.

The meeting shall deal only with business on the Agenda, unless the Chairman shall grant permission to deal with any urgent business. Business on Agenda.

Seven members shall form a quorum. If any member of the Board shall fail to attend one-half of meetings of the Board in any one year, except by reason of absence on leave, illness or other good and sufficient cause, his absence shall be brought to the notice of the Governor. Quorum.

All cheques for payment of monies to be signed by the Vice-President and countersigned by another member of the Board. A statement of the expenditure incurred shall be submitted at each monthly meeting. Expenditure.

The accounts of the Board shall be audited annually by an accountant. Audit of accounts.

Minutes of proceedings at all meetings shall be printed and published in the *Royal Gazette*. Minutes of proceedings.

The following books shall be kept:—

(1.) A general register of the correspondence of the Board.

(2.) A letter book.

(3.) A minute book.

(4.) A banking account and a petty cash book showing the receipts and expenditure of the Board, and any others as may from time to time be found necessary.

It will be the duty of the Secretary subject to the direction of the President or Vice-President to summon and attend all meetings of the Board or Special Committees. Duties of Secretary.

He shall keep a record of the proceedings of all meetings. Such records together with all papers and books of the Board shall be kept in the office of the Board and shall be in charge of the Secretary, who shall be in attendance at the office on such days and at such hours as the Board may direct and shall arrange for access by the members of the Board to such records papers and books.

He shall conduct the correspondence and the general business of the Board, subject to the direction of the Board and will be charged with the editing of all the publications of the Board.

He will be charged with the organisation and management of such Agricultural Shows as the Board may decide to hold in the Colony, and shall superintend any Agricultural or other experimental work undertaken by the Board, and shall visit and report on same when required by the Board so to do.

He shall perform any other duties which may be required of him by the Board.

Approved at a meeting of the Board held on Friday, the 8th January, 1909.

A. E. COLLENS,
Secretary, (*pro tem.*)

The first meeting of the Board of Agriculture of Trinidad and Tobago was held in the Council Chamber, (Government Buildings, Port-of-Spain), at 2 p.m. on Friday, 27th November, 1908.

Present:

His Excellency the ACTING GOVERNOR (President) *in the Chair*.

The DIRECTOR OF AGRICULTURE, (Vice-President).

The Honourable G. T. FENWICK, C.M.G.

" " S. HENDERSON.

" " CARL de VERTEUIL.

" " WILLIAM KAY.

Lieut.-Colonel J. H. COLLENS, V.D.

Captain R. K. WRIGHT.

Mr. J. D'ABADIE.

" J. MOODIE.

" H. E. MURRAY.

" L. de VERTEUIL.

" BERT de LAMARRE.

Appointments of Secretary and Clerical Assistant.

The Director of Agriculture was authorised to employ Mr. A. E. Collens as Scientific Assistant and Secretary at $48 per month, and a Clerical Assistant at $15 per month. These appointments to be purely temporary, and to be subject to termination at any time by the Board.

Mr. A. E. Collens' appointment as Scientific Assistant.

Agricultural fund.

It was resolved that the funds of the Board now in the Treasury should be lodged at the Colonial Bank, and in future transferred monthly from the Treasury to the Bank. All cheques for payment of monies to be signed by the Director and countersigned by another member of the Board.

Additional cacao members on Board.

On the suggestion of the Hon'ble Carl de Verteuil that the Cacao Industry should be more strongly represented on the Board, the President requested him to forward the names of gentlemen interested in that industry for consideration.

Agricultural Tax for 1909.

It was pointed out that the Ordinance for raising funds in aid of Agriculture would terminate on the 31st December next, and that a new Ordinance should be submitted to the Legislative Council. On the suggestion of the Hon. G. T. Fenwick, His Excellency appointed the Hon'ble C. de Verteuil and Mr. H. E. Murray to confer together and report upon the rate of the proposed Agricultural Tax for the year ending 31st December, 1909.

Purchase of Typewriter duplicating machine.

The Director stated that a Typewriter and duplicating machine were required. The Board approved of the purchase of a Typewriting and of a duplicating machine.

Stationery and Furniture.

The purchase of stationery and furniture was allowed to stand over pending the appointment of a Committee to confer with the Director as to details.

Railway tickets.

The issue of Railway tickets to Members attending the meetings of the Board was decided to be charged to the funds of the Board.

Use of the Board's funds in purchasing destructive insects.

After some discussion it was decided that the sum of £10 should be set apart for the purpose of purchasing destructive insects, and that the Director should furnish a report on the results at a future meeting of the Board.

Appointments. Assistant Director.

It was resolved on the motion of the Hon. C. de Verteuil, seconded by the Hon. S. Henderson, that the contribution of the Board to the Treasury towards the salary of the Assistant Director be increased to

£455 per annum so as to bring the total salary up to £900 per annum, in order to secure if possible the services of Mr. J. B. Carruthers, and His Excellency promised to ask the Secretary of State to offer the appointment to Mr. Carruthers and to request a reply by telegram.

Entomologist. On the motion of the Hon. C. de Verteuil, seconded by Mr. Bert de Lamarre, the salary of the Entomologist was fixed at £400. It was decided that the post be offered to Mr. F. W. Urich on an engagement not exceeding two years at this salary.

Mycologist. It was agreed after discussion on the motion of Lieut.-Colonel Collens, seconded by Hon. W. Kay, that the salary of the Mycologist be £400 per annum, and the Director was authorised to take steps to secure a suitable person.

Committees. His Excellency the Acting Governor appointed the following Committee to deal with and report upon:—

(*a.*) The framing of Rules and Regulations;

(*b.*) The formation of Experimental Stations;

(*c.*) The desirability of instituting examinations in Agriculture;

and to advise the Director on questions of Expenditure, &c.

The Director of Agriculture (Chairman).
,, Hon. G. T. Fenwick, C.M.G.
,, ,, S. Henderson.
Mr. Bert de Lamarre.
Captain R. K. Wright.

Printing of Minutes. On the proposal of the Hon. G. T. Fenwick, C.M.G., it was decided that the Minutes of the meetings should be circulated among the members of the Board after each meeting.

Adjournment. The meeting adjourned until Friday the 11th of December, 1908, at 2 p.m.

A. E. COLLENS.
Secretary, (*pro tem.*)

Confirmed,

S. W. KNAGGS,

11th December, 1908.

At a meeting of the Board of Agriculture, held in the Council Chamber (Government Buildings, Port-of-Spain), at 2 p.m., on Friday, 11th December, 1908.

Present:

His Excellency THE ACTING GOVERNOR (President), *in the Chair.*
The DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon'ble S. HENDERSON.
,, ,, C. de VERTEUIL.
Captain R. K. WRIGHT.
Mr. J. D'ABADIE.
,, J. P. BAIN.
,, J. MOODIE.
,, H. E. MURRAY.
,, W. GREIG.
,, BERT de LAMARRE.
,, A. E. COLLENS (Secretary *pro tem.*)

Minutes—Confirmation. The Minutes of the last meeting which had been printed and circulated were taken as read and confirmed.

The Vice-President received from Mr. Bain a letter expressing his regret at not being able to attend the last meeting and Messrs. G. T. Fenwick, W. G. Kay, and J. H. Collens had notified him that day that they were unable to be present at this meeting. Absent members.

Mr. Bert de Lamarre moved the following resolutions which were passed:— Government Farm.

(1.) "That an application be sent to the Chairman of the late "Advisory Committee of the Government Farm for documents "in his custody containing much useful information."

The Secretary was instructed to forward a Copy of the resolution to the Hon'ble Acting Colonial Secretary.

(2.) "That the Advisory Committee of the Board should inspect "the Government Farm and report to the Board."

Seconded by Captain Wright.

Mr. H. E. Murray was invited to join the Committee when inspecting the Farm.

The correspondence between the Vice-President and Mr. Urich was read. The Board resolved that Mr. Urich be appointed as Entomologist for a term of two years at £400 per annum, on the conditions specified in his letter of the 9th December, and on the understanding that he will also be required to temporarily relinquish his posts of Adjutant to the Light Infantry, and Clerk to the College Council. This appointment to take effect from the 1st January, 1909. Appointment of Entomologist.

The consideration for the purchase of a new Seismograph recorder was referred to the Director to deal with departmentally. Seismograph.

Resolved.—That the Government be advised to expend a sufficient sum from the available balance of the vote for Experimental Plots in carrying out experiments at *River* Estate. *River* Estate.

His Excellency appointed the following Committee to visit and report upon *River* Estate:—

The Vice-President, Hon'ble Carl de Verteuil, Mr. J. D'Abadie.

Resolved.—To extend the cultivation of new varieties of seedling canes and to discontinue the present plot owing to the unsatisfactory growth of the canes. Seedling canes.

Resolved.—That the quarterly publication of the Botanic Gardens Bulletin should be continued for the present. Botanic Gardens Bulletin.

The Director stated that so far no specimens of the cane sucker moth had been received from the general public, but that on Caroni Estate the returns of moths captured during the previous fortnight were as follows:— Destruction of Cane Moth.

To week ending November 28th	...	...	245
,, ,, December 5th	...	...	1,026
	Total...	...	1,271

It was proposed by the Vice-President that the amount voted for experimental work in the Department of Agriculture should be increased from £100 to £300, and it was agreed that application should be made to the Government accordingly. Funds for Experiments.

The correspondence on this subject between the Director and the Acting Commissioner of the Imperial Department of Agriculture, Barbados was read, and it was decided that the Director should bring up the question at a later date. Examinations in Agriculture.

At the request of Lieut.-Colonel Collens who was unavoidably absent, the consideration of the question was postponed. School Gardens.

Coconut disease.

With reference to the application for assistance in the treatment of diseased Coconuts at Laventille, the Vice-President stated that the Agricultural Instructor had visited the spot and reported that the trees were infected from neighbouring plantations. The Vice-President suggested that a Committee should be appointed to consider what steps could be taken to remove the many dead and unhealthy trees in that locality. It was decided that nothing could be done until a Mycologist was appointed. It was agreed that the appointment be filled with as little delay as possible.

Agriculture Tax for 1909.

The Committee appointed at last meeting reported and recommended that the following rates be charged as Agricultural Taxes for 1909:—

Cacao	... ...	... 1d. per 100 lbs.
Sugar	... ...	... 1½d. ,, 1,000 lbs.
Coconuts	... ...	... 3d. ,, 1,000.
Copra	... ...	... 1/6d. per ton.

The recommendation was approved.

Applications for employment.

Applications for employment were referred to the Advisory Committee.

Minutes of Advisory Committee.

The Minutes of the two meetings of the Advisory Committee were read and the Secretary was directed to have the rules printed in draft and to circulate them among the members of the Board for consideration.

Mr. C. de Verteuil was appointed on the Advisory Committee.

Appointments of additional members on Board.

The following names were submitted for appointment on the Board.

Mr. E. L. Sellier, Mr. Wade, Mr. Eugene André.

Adjournment.

Owing to the holidays the meeting was adjourned for four weeks, to Friday, 8th January, 1909, but special meetings would be called if necessary for any urgent business.

The meeting then adjourned to Friday, 8th January, 1909, at 2 p.m.

A. E. COLLENS,
Secretary, (*pro tem.*)

Confirmed,

S. W. KNAGGS,
21st December, 1908.

At a special meeting of the Board of Agriculture, held in the Council Chamber, (Government Buildings, Port-of-Spain), at 2 p.m., on Monday, 21st December, 1908.

Present:

His Excellency The Acting Governor (President) *in the Chair.*
The Director of Agriculture (Vice-President).
The Honourable G. T. Fenwick, C.M.G.
,, ,, S. Henderson.
,, ,, C. de Verteuil.
Captain R. K. Wright.
Mr. J. P. Bain.
,, J. H. Wade.
,, J. Moodie.
,, H. E. Murray.
,, W. Greig.
,, Bert de Lamarre.
,, A. E. Collens (Secretary, *pro tem.*)

Confirmation of Minutes.

The minutes of the last meeting were read and confirmed.

Copies of a telegram from the Right Honourable the Secretary of State *re* appointment of an Entomologist having been previously circulated among the members, replies received from the following were read:— Telegram *re* Entomologist.

Messrs. G. T. Fenwick, S. Henderson, L. de Verteuil, Bert de Lamarre, W. G. Kay, J. Moodie, H. E. Murray, J. P. Bain.

and the members present were invited to express their opinions.

His Excellency having another appointment vacated the chair, which was then taken by the Vice-President.

After discussion the following resolutions were carried:—

(1.) "That an Entomologist alone would not be sufficient."

(2.) "That an Entomologist has already been appointed, who will "give the matter his immediate attention—it may be necessary "to have an expert to assist him, but no steps need be taken "until his report be received."

Mr. J. J. McLeod was recommended to His Excellency as a desirable member to have on the Board. Additional member on Board.

The meeting then adjourned at 3 p.m. Adjournment.

A. E. COLLENS,
Secretary, (*pro tem.*)

Minutes confirmed.

P. CARMODY,
Chairman.

8th January, 1909.

At a meeting of the Board of Agriculture, held in the Council Chamber (Government Buildings), on Friday the 8th January, 1909, at 2 p.m.

Present:

The Vice-President (*in the Chair*).
,, Hon'ble G. T. Fenwick, C.M.G.
,, ,, William G. Kay.
,, ,, Carl de Verteuil.
Lieut.-Colonel J. H. Collens, V.D.
Captain R. K. Wright.
Mr. Bert de Lamarre.
,, J. Moodie.
,, H. E. Murray.
,, J. H. Wade.
,, L. de Verteuil.
,, J. D'Abadie.
,, E. L. Sellier.
,, A. E. Collens (Secretary *pro tem.*)

The Vice-President stated that he had received from His Excellency the President, and from Messrs. J. P. Bain and J. J. McLeod letters expressing their regret at being unable to attend the meeting. Absent members.

In the absence of the President, the Vice-President was elected in the Chair.

The Minutes of the special meeting which had been printed and circulated were taken as read and confirmed with the following addition:— Minutes of special meeting—Comfirmation of.

"His Excellency having another appointment vacated the Chair, "which was then taken by the Vice-President"

Consideration of rules and regulations.

The draft rules and regulations were considered and after verbal alterations and the addition of a rule for the audit of accounts confirmed.

Resolved :—

Audit.

(1.) That the accounts of the Board be audited by an outside accountant.

River Estate vote.

(2.) That the consideration of the vote for maintenance of *River* Estate, and establishment of the Experimental Cacao plots be left over till the report of the Special Committee be received.

Transfer of £200 to Board's funds for agricultural experiments.

(3.) That the Government be approached to transfer to the Department of Agriculture, the sum of £200 from the £600 annually voted to Agricultural Society.

Analyses of soils—Payment for.

(4.) That the sum of £100 be allocated for the analyses of soils, etc., in connection with the experimental plots.

Purchase of Acetylene trap lamps.

(5.) That the Vice-President be authorized to obtain 6 Acetylene trap lamps for use in the destruction of frog-hoppers and other injurious insects.

Purchase of fungicides and insecticides.

(6.) That the Vice-President be authorized to expend not more than £25 in procuring a stock of insecticides and fungicides not obtainable locally.

Transfer of Agricultural Instructors to Education Department.

(7.) That the transference of the Agricultural Instructors to the Education Department be recommended.

Appointment of Committees.

The following Committees were appointed to report on all matters concerning the Cacao and Sugar industries :—

Cacao Committee.	Sugar Committee.
Hon'ble C. de Verteuil.	Hon'ble G. T. Fenwick.
Mr. J. d'Abadie.	,, S. Henderson.
,, L. de Verteuil.	,, W. G. Kay.
,, J. P. Bain.	Mr. J. Moodie.
,, J. H. Wade.	,, H. E. Murray.
,, E. L. Sellier.	,, J. J. McLeod.
,, Bert de Lamarre.	,, Bert de Lamarre.

Plant Inspectors.

The Secretary was authorized to advertise in the daily papers for applications for the appointment of two Plant Inspectors at a salary of $60 per month each with $20 monthly horse allowance.

Mr. Fenwick drew attention to the ill-health of the young trees in Marine Square and South Quay, and suggested that some action be taken.

Application for employments.

It was decided that the names selected by the Advisory Committee should be brought up again for consideration when any vacancies occur.

Agricultural tax.

The Chairman reported that the amount collected from the Agricultural Tax for the month of December was £532 9 10, of which £508 was paid for cacao.

Coconut beetle.

A letter from Messrs. Gordon Grant & Co. was read with reference to the destruction caused by beetles to their coconut trees, and suggesting that the Board should offer a reward for captured specimens as was done in the case of the *Castnia licus* moth.

It was decided that the matter should be referred to the Entomologist, and the Secretary was directed to inform Messrs. Gordon Grant & Co. that the moths captured on the *Caroni* Estate were paid for by the Proprietors.

The Board was informed that 8,139 adult cane sucker moths had been captured for the past six weeks. Castnia licus returns.

The Chairman announced that he had received from Tobago some cacao pods damaged by "Thrips" and also specimens of the Thrips. This has been reported probably for the first time in that Island. It has been previously observed attacking cacao leaves in Trinidad. Thrips.

Copy of a circular *re* damage done to cacao pods by the Carpenter Bird was read, and the Chairman stated that he would be glad if members would send in their reports so that he could summarise them. Carpenter Bird.

The Board having recommended the transfer of the Agricultural Instructors to the Education Department the question of School Gardens was struck out. School gardens.

The following amendment of the Plant Protection Ordinance formulated at the meeting of the Advisory Committee was read and approved:— Amendment of the Plant Protection Ordinance.

"The Chief Inspector may make an order within a reasonable limit "of time stated on such order, for the removal, disinfection, "burial or destruction of trunks, stems, branches, fruit, pods, "leaves, or other parts of any dead or dying trees or plants "which in his opinion are likely to produce, promote or dis- "seminate disease."

Letters from Mr. Rorer of the United States Department of Plant Pathology applying for the post of Mycologist, and from Mr. Busck of the Department of Entomology, recommending Mr. Rorer, were read. Mycologist.

The Chairman mentioned that he had also inserted advertisements in "Nature" and in "Science" and expected further applications.

A letter from Mr. Urich was read stating his readiness to accept the post of Entomologist provided that he was allowed to retain the Adjutancy of the Light Infantry. Entomologist.

The question was discussed and put to the vote and decided in the affirmative by a majority. This modification was then adopted:—"It was "agreed that Mr. Urich should be allowed to retain his appointment as "Adjutant so long as in the opinion of the Board it does not interfere in "any way with his duties as Entomologist."

Mr. Louis Seheult, B. Sc., was recommended to His Excellency as a desirable member to appoint on the Board. Additional member to Board.

Mr. Bert de Lamarre moved the following resolution:— Mr. Bert de Lamarre's motion *re* "Patents' law."

"That an amendment should be made in the laws relating to the "granting of patents so as to prevent the patenting of a process "unless it was provided to manufacture that article locally "within a limited time."

It was decided to refer the matter to the Sugar Committee, and in the meantime to bring the facts to the notice of the Government.

The meeting then adjourned to Friday, the 29th January, at 2 p.m. Adjournment.

A. E. COLLENS,
Secretary, (*pro tem.*)

Confirmed.

S. W. KNAGGS,

29th January, 1909

At a meeting of the Board of Agriculture, held in the Council Chamber (Government Buildings), on Friday, the 29th January, 1909.

Present:

His Excellency the ACTING GOVERNOR (President), *in the Chair.*

The DIRECTOR OF AGRICULTURE (Vice-President).

,, Hon'ble CARL de VERTEUIL.

,, ,, G. T. FENWICK, C.M.G.

,, ,, S. HENDERSON.

,, ,, WILLIAM G. KAY.

,, ,, A. WARNER.

Lieut.-Colonel J. H. COLLENS, V.D.

Captain R. K. WRIGHT.

Mr. E. ANDRE.

,, J. P. BAIN.

,, BERT de LAMARRE.

,, J. D'ABADIE.

,, WILLIAM GREIG.

,, J. J. MCLEOD.

,, J. MOODIE.

,, H. E. MURRAY.

,, A. E. COLLENS (Secretary, *pro tem.*)

Confirmation of Minutes.

The Minutes of the last meeting, which had been printed and circulated, were taken as read and confirmed.

Appointment of Mr. Carruthers as Assistant Director.

The President announced that he had received a telegram from the Right Honourable the Secretary of State, stating that Mr. Carruthers had accepted the appointment of Assistant Director.

Mr. Lewton-Brain had also telegraphed an application for this post, but had been informed that the appointment was already filled.

Correspondence *re* appointment of Mycologist.

Letters were read from:—

(1.) Mr. W. T. Stockley asking to be allowed to withdraw his application for the post of Mycologist.

(3.) Mr. R. Nicol, M.A., B.Sc., in reply to the advertisement in "*Nature.*"

(3.) Messrs. Alden P. Speare of the New York Agricultural Experiment Station and J. G. Grossenbacher of the United States Gipsy Moth Commission in reply to the advertisement in "*Science.*"

(4.) Dr. Erwin F. Smith, Chief of the Laboratory of Plant Pathology, and Dr. Roland Thaxter, Chief of the Laboratory of Cryptogamic Botany, Harvard University recommending Mr. J. Birch Rorer, of the Bureau of Plant Industry as Mycologist.

(5.) Dr. E. H. Jenkin, Connecticut Agricultural Experiment Station, giving the names of two suitable candidates.

6.) Mr. Essed, Forest Botanist, Suriname, applying for any vacancy at £400 per annum. It was decided that Mr. Essed be informed that all the vacancies on the Expert Staff had already been filled.

After discussion it was agreed that the appointment of Mycologist on the terms already published be offered to Mr. J. B. Rorer.

Correspondence re orchids, etc.

Correspondence from a firm in Caracas offering orchids and Natural History specimens for sale was submitted to the Board.

Receipt of cuttings of seedling canes from British Guiana.

A supply of the following types of canes has been received from Professor Harrison and planted in the best part of the St. Clair Station.

D 116	...	...	...	D 2468
„ 145	...	...	...	„ 3956
„ 366	...	...	...	„ 4397
„ 625	...	...	...	„ 4805

The suggestion that future supplies should be planted at St. Augustine was referred to the Sugar Committee.

Mr. Bert de Lamarre added to Sugar Committee.

The Secretary was directed to add Mr. Bert de Lamarre's name to the Sugar Committee.

Mr. Bert de Lamarre's application for loan of Minutes of late Advisory Committee Government Farm.

Correspondence between Mr. Bert de Lamarre and the Vice-President *re* loan of the Minutes of the late Advisory Committee of the Government Farm, was read.

The Board agreed that Mr. Bert could have the use of these Minutes.

The Vice-President informed the Board that Mr. Urich began his duties on the 16th instant.

Report of Entomologist.

A preliminary report of the Entomologist on the coconut beetles was submitted together with photographs of the "bearded weevil."

It was decided that Mr. Urich should continue to investigate the possibility of disease being spread by these beetles, and circulars should be sent to persons interested in coconut cultivation asking for observations on the habits, etc., of the "bearded weevil," and for specimens of other insects found damaging coconut trees.

A borer, which on examination by him was found to be a Castnia licus, was stated to have been picked out of the bud of a coconut tree.

Entomologist's estimate, apparatus, etc.

The estimate of the Entomologist for apparatus and fittings was referred to the Advisory Committee.

Report of Committee on River Estate.

The report of the Advisory Committee on *River* Estate was read and approved. It was moved by the Hon'ble A. Warner and seconded by Captain Wright that this report be adopted.

Manager, Government Farm.

The question of amalgamating the appointments of Manager, Government Farm and St. Augustine, was submitted for the advice of the Board.

The Board advised that no permanent appointment should be made for one year, and that the present arrangements with the acting Manager should continue during that period.

Purchase of Kitson lamps re destruction of frog hoppers, etc.

A recommendation for the purchase of two Kitson lamps for use in connection with the destruction of frog hoppers and other injurious insects was referred to the Advisory Committee.

The President stated that the Right Hon'ble the Secretary of State had directed that the Ordinance relating to the Board should be amended; and that these amendments would be laid before the Legislature at an early date.

Circulars.

The Vice-President stated that he had received applications from some large proprietors for extra copies of the Circulars issued by the Department for re-issue to different estates, and suggested that Circulars might be posted direct to them if the Managers sent in a list of names.

Application for appointment as Plant Inspectors.

The Secretary stated that 33 applications had been received up to that date. It was decided that the selection of appointments should be left to the Advisory Committee.

A letter was read from Mr. Harry Vincent, applying for the post of Secretary to the Board.

Appointment of Secretary.

Resolved :—That the question of the appointment of the Secretary be brought up at the next meeting.

The meeting then adjourned to Friday the 26th February, 1909.

A. E. COLLENS,
Secretary, (*pro tem.*)

Confirmed.
S. W. KNAGGS,
26th February, 1909.

At a meeting of the Board of Agriculture, held at the Council Chamber, on Friday the 26th February, 1909, at 2 p.m.

Present:

His Excellency the ACTING GOVERNOR (*in the Chair*).
The VICE-PRESIDENT.
„ Hon'ble R. S. A. WARNER, K.C.
„ „ G. T. FENWICK, C.M.G.
„ „ CARL de VERTEUIL.
„ „ S. HENDERSON.
„ „ WILLIAM KAY.
Lieut.-Colonel J. H. COLLENS, V.D.
Captain R. K. WRIGHT.
Mr. J. D'ABADIE.
„ LUDOVIC de VERTEUIL.
„ WILLIAM GREIG.
„ J. MOODIE.
„ H. E. MURRAY.
„ L. SEHEULT.
„ J. H. WADE.
„ A. E. COLLENS (Secretary *pro tem.*)

Communications were received from Messrs. McLeod, Bain and Bert de Lamarre, expressing regret at not being able to be present at this meeting.

Minutes—Confirmation of.

The Minutes of the previous meeting, having been printed and circulated among the Members, were taken as read and confirmed.

Correspondence.

A despatch from the Right Honourable the Secretary of State for the Colonies removing the restrictions against the importation of Cattle by Immigrant ships was read.

Applications for the post of Mycologist from
Mr. A. W. Bartlett.
„ H. T. Güssow.
„ L. D. Larsen.
and further testimonials in support of Mr. Rorer, were submitted for the information of Members.

Accounts.

The Board approved the payment of 90c. for a railway ticket, and $5.88 for a cablegram to the United States Department of Agriculture. The total expenditure to date amounted to $606.95.

Reports.

The report of the Entomologist for the month of February was read, and also the report of the Advisory Committee.

Resolved :—

Agricultural Inspectors.

(1.) That Mr. L. A. Brunton and Mr. D. C. Plummer be appointed Agricultural Inspectors.

(2.) That the report on the Government Stock Farm be adopted and that the proposals made in it be recommended for the consideration of the Government. Report on Govt. Stock Farm.

(3.) That the Seedling canes received from other Colonies be planted either at *Valsayn* or *River* Estate. Seedling canes.

(4.) That the present temporary arrangement with regard to the post of Secretary be continued. Secretary.

The following resolutions were moved by the Hon. C. de Verteuil, and seconded by the Hon. A. Warner:— *River* Estate.

That *River* Estate should be worked by a system of loans similar to that of *St. Augustine*.

That in the interests of the Estate and the Cacao Industry of the Colony, the revenues derived from *River* Estate after payment of expenses be set apart for experiments on cacao.

An application from the Hon. H. L. Thornton for the purchase of a Centrifugal Rubber Machine was at his request postponed, pending further information. Centrifugal Rubber Machine.

A paper on Nicaraguan Cacao Shade as a mulch by Mr. J. P. Bain was read. The paper was much appreciated on account of its practical nature, and it was decided that it should be published in the next issue of the Bulletin of the Department of Agriculture. Paper by Mr J. P. Bain.

The meeting then adjourned to Friday, the 26th March, 1909, at 2 p.m. Adjournment.

A. E. COLLENS,
Secretary, (*pro tem.*)

Confirmed.

S. W. KNAGGS,
26th March, 1909.

At a meeting of the Board of Agriculture, held at the Council Chamber, on Friday, 26th March, 1909, at 2 p.m.

Present:

His Excellency the Acting Governor (*in the Chair*).
The Vice-President.
,, Hon'ble R. S. A. Warner, K.C.
,, ,, G. T. Fenwick, C.M.G.
,, ,, C. de Verteuil.
,, ,, S. Henderson.
,, ,, W. Kay.
Lieut.-Colonel J. H. Collens, V.D.
Captain R. K. Wright.
Mr. J. P. Bain.
,, Bert de Lamarre.
,, J. D'Abadie.
,, W. Greig.
,, J. Moodie.
,, H. E. Murray.
,, L. Seheult.
,, E. L. Sellier.
,, J. H. Wade.
,, A. E. Collens (Secretary *pro tem.*)

The Minutes of the previous meeting having been printed and circulated among the members, were taken as read and confirmed. Confirmation of Minutes.

Meetings open to the public.

His Excellency submitted for the decision of the Board, a suggestion made to him that the meetings of the Board should in future be open to the public and the press.

It was agreed that the time had now arrived when the meetings of the Board should be open to the public, and the Secretary was instructed to give the necessary notification.

Expenditure.

The total expenditure to date amounted to $719 05.

Reports.

The following reports were read :—

1. Report of Entomologist for the month of March. Ordered to be printed.
2. Inspection report by Vice-President on cacao grown without shade. Ordered to be printed.
3. Report by Scientific Assistant on a visit to the Tamana Cacao district. Ordered to be printed.
4. Extract from yearly report of Imperial Institute (1906 and 1907) on cacao.
5. Analysis and valuation of a sample of Castilloa Rubber from Tobago. Ordered to be printed.

A report on a visit of inspection to Tobago by the Acting Superintendent, Botanic Gardens, was postponed.

It was decided that the Vice-President should select from the reports previously read such as are suitable for publication in future issues of the *Bulletin*, and that the proceedings of the Board to date should also be published in the *Bulletin*.

The suggestion that the *Bulletin* should be published monthly, was held over for future consideration.

Letters.

The following letters were submitted :—

(*a*.) Letter from Mr. L. de Verteuil, expressing regret at not being able to be present at the meeting.

Increase of Duty—Bounty Fed Sugar.

(*b*.) A circular despatch from the Right Honourable the Secretary of State for the Colonies, containing the report of the President of the Permanent Sugar Commission, dated 9th December, 1908, in which it was decided to increase the duties on sugars from Brazil and Mexico, to the following rates :—

BRAZIL —Raw Sugar ...	...	... 36	francs	the 100	kilos.
Refined Sugar	...	... 35	,,	,,	,,
MEXICO—Raw Sugar ...	...	... 3	,,	,,	,,
Refined Sugar	...	... 3	,,	,,	,,

and to lower the present rate on Spanish sugars from 27 francs to 22 francs per 100 kilos for both raw and refined sugar.

(*c*.) From J. B. Rorer, stating his intention of leaving the United States, on the 5th April.

(*d*.) From Messrs. L. A. Brunton and D. C. Plummer accepting the appointment as Agricultural Inspectors from the 1st April.

Appointment of Secretary.

(*e*.) From Mr. E. J. Scott, applying for the post of Secretary.

(*f*.) Letter from the Secretary of the Agricultural Society, suggesting the amalgamation of the Secretaryship of the Board of Agriculture, with that of the Agricultural Society.

It was decided that these applications should lie on the table until the consideration of the appointment of a permanent Secretary came before the Board.

(*g*.) Letter from the Secretary, Planters' Association, Tobago, suggesting that the Ratin Co. be approached with a view to the destruction of rats in Tobago. The Vice-President stated that he had made enquiries as to the cheap preparation of the virus and had been informed that in Jamaica, it could be prepared at a cost of one penny per tube; he was awaiting replies to proposals that had been made to the Danysz Virus Co. **Destruction of rats in Tobago.**

It was decided that the Vice-President be allowed to spend a small sum from the Board's funds to provide assistance for the purpose of carrying out experiments on the preparation of rat virus in the Colony.

A proposal by the Vice-President to hold periodical Agricultural Conferences at various districts in the Colony was favourably received. The principal was approved by the Board and it was decided that the question be brought up again. **Agricultural Conference.**

The meeting then adjourned to Friday, 23rd April, 1909, at 2 p.m. **Adjournment.**

A. E. COLLENS,
Secretary, (*pro tem.*)

Confirmed.

23rd April, 1909. S. W. KNAGGS.

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I.—SUGAR.

88.—Badilla Cane.

Badilla Cane, (New Guinea No. 15).—The Department has been notified that a consignment of this cane is on its way from Queensland.

89.—Results of Analysis of Seedling Canes grown at the Government Laboratory.

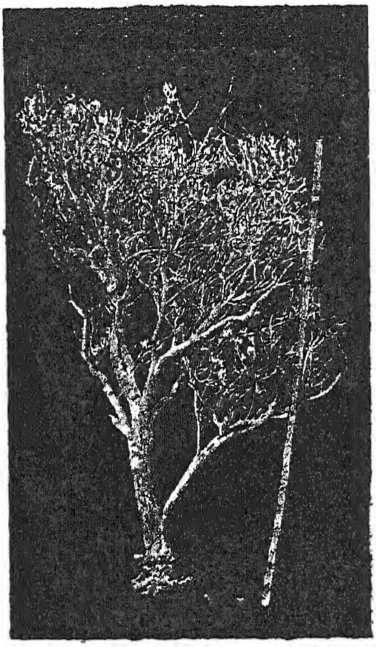
(*Read at the meeting of the Board, 18th June, 1909.*)

The following are the results of analysis of selected samples of Seedling Canes grown on the small experimental plot at the Government Laboratory. These canes (with the exception of D. 625 which was planted in June 1908), were planted in April 1908, and cut on June 5th, 1909:—

No. of Cane.	Average weight of each cane.		Per cent. Juice.	Specific gravity of juice.	Brix.	Per cent. Sucrose.	Per cent. Glucose.	Per cent. Solids non-sugar.	Quotient of purity.
Laboratory No 2.	6·0	lb.	67·3	1·0877	21·0	19·92	0·19	0·89	94·7
T. 202 ...	4·4	„	65·8	1·0837	20·1	19·37	0·32	0·41	96·3
Bourbon ...	6·5	„	71·4	1·0779	18·8	17·15	0·57	1·08	91·2
T. 39 ...	4·5	„	68·9	1·0886	21·2	20·29	0·22	0·69	95·7
T. 83 ...	4·0	„	69·3	1·0895	21·4	20·37	0·12	0·91	95·1
T. 192 ...	2·9	„	64·2	1·0757	18·3	16·90	0·44	0·96	92·3
D. 625 ...	8·3	„	71·6	1·0652	15·9	12·32	2·70	0·88	77·4

Joseph de Verteuil,
Assistant Government Analyst.

Government Laboratory,
15th June, 1909.



Guayule

Reproduced from the Journal of Industrial and Engineering Chemistry. *See page 74.*

From a photograph taken at the Government Laboratory.
See page 12, Bulletin No. 61.

NODULES ON ROOTS OF BOCARE IMMORTEL.

Vide page 12 (Bulletin 61).

From a photograph taken at the Government Laboratory.
See page 12, Bulletin No. 61.

NODULES ON ROOTS OF ANAUCO IMMORTEL.

Vide page 12 (Bulletin 61).

90.—Depredations of the Sugar-Cane Grub.

(Over Seas Daily Mail.)

Some estimate of the damage done to the sugar-cane by the grub known as the sugar-cane beetle may be gathered from the statement made by the Government Entomologist of Queensland.

In one season in a district of Queensland the loss caused by sugar-cane grubs (Lepidiota) amounted to between £40,000 and £50,000.

It was recommended to a grower of the sugar-cane on the Bloomsfield River that a bisulphide of carbon injector be purchased and experiments made in injecting bisulphide of carbon into the soil. Excellent results followed the application. The grubs feed on the roots of the sugar-cane and are suffocated by the carbon bisulphide vapours injected into the soil.

II.—CACAO.

91.—Cacao without Permanent Shade.

(Read at the meeting of the Board, 26th March, 1909.)

Since the last meeting I visited two districts in which experiments are being made by Mr. Stollmeyer in growing cacao without permanent shade.

The first is on San Carlos Estate in the district of Guanapo where the shade has been removed from 500 trees about 8 or 9 years ago. The trees look quite healthy and I was told that they gave yields as satisfactory as the other neighbouring trees but no record of actual pickings has been kept.

Mr. Stollmeyer is so satisfied with the results that he has already ringed shade trees covering 4,500 cacao trees, and he intends removing the shade from the whole estate of 55,000 trees.

The second was a small plot at Santa Cruz which was grown altogether without permanent shade. The trees had more of a shrubby appearance than might be expected from their age; but this may have been due to a poor soil.

In addition to this brief record of results, it has been mentioned that if the practice of manuring cacao becomes general, the question of retaining shade trees, which will absorb a large part of the manures added, will have to be considered from that point of view.

Mr. Stollmeyer has another unshaded plot at Montserrat, and he has promised to write a short report on the results he has so far obtained.

P. Carmody.

92.—Report on a visit to Tamana on 13th March, 1909.

(Read at the meeting of the Board, 26th March, 1909.)

After leaving Cumuto I passed several Cacao Estates, on some of which even from the roadside the external evidences of canker were fairly conspicuous. There is a fair amount of black blight in the district especially on mango trees and also another orange-red type common on guavas and oranges, these fungi however are saprophytic and chiefly disfigure the trees; if present to a large extent however they interfere with the proper functions of the leaf.

Diseases chiefly brought about by neglect and apathy are fairly common among the smaller peasant proprietors, and especially thread blight. The latter is spread by the broken branches and dead leaves with the threads or mycelium falling or being carried by the wind and lodging on healthy trees to which the mycelium readily spreads. It is frequently met with on immortel, nutmegs, and even forest trees especially *Bois mulatre* (wild tamarind N. O. Leguminosae Pentaclethra sp. ?) and its presence is readily indicated by a mass of dead leaves in a tree without any sign of broken branches. Another form of thread blight or brown thread blight (*Pellicularia koleroga*, Cooke) was found on an Aralia hedge at Cumuto Station. I have found this pest extensively in the St. Ann's Valley on Cacao, roses, crotons, and especially coffee—on the latter besides killing the leaves it also causes the young and immature berries to shrivel up. It has been reported as a troublesome coffee disease in Jamaica and Puerto Rico, and to some extent also in Venezuela.

In one neglected cacao patch I found evidences of a wound fungus *Eutypa erumpens*, Mass—a fungus responsible for the death of many forest trees and which has been doing damage latterly among mangoes and other fruit trees in the neighbourhood of Port-of-Spain.

On one estate which I visited the manager (Mr. H. Fahey) goes in extensively for remedial measures against disease, cutting out all canker marks even to the slightest traces of discolouration, and afterwards tarring the wound. Any tree that shows extensive signs of canker is treated as above and one or two chupons or suckers allowed to grow from the base of the tree. After the suckers have grown to a respectable size, if the canker spreads or the yield is inferior and failing, the parent stem is cut close to the ground, the surface well tarred and the chupons are allowed to develop in its place and in about two years time grow into good sized trees.

On this estate it was conclusively proved that canker is capable of entering the tree through the cushion of an infected pod. At first I was somewhat doubtful, because first evidences seemed to me to prove equally as well that the canker might have entered the pod through the cushion. Pods were met with in several stages where the canker discolouration extended to the stalk, in others to the cushion, and many for several inches in the cambium layer. I may mention that the common pod canker in this district is a Nectria sp. An unripe pod with a peculiar distorted (and atrophied) appearance developed characteristic Diplodia spores the day after it was picked.

Insects.—The characteristic scabby appearance of the leaves of many trees pointed to the presence of thrips and these were found in almost every instance, they were also found on many pods. On two trees, all the pods were of a rusty brown colour; the Manager stated that he was unable to tell whether these pods were ripe without removing the outer skin. Thrips were in evidence on these also, the injury however was only surface deep, and underneath the outer skin the pods were quite green and healthy.

Many pods were found attacked by mealy bugs and more often by homopterous bugs which for want of a better name I propose to call Pod hoppers (*Horiola* sp. and another type). These were always accompanied by their attendant ants; two unusual types of ants were also met accompanying these bugs. *Cryptocerus sp.* (flattened head) and *Strumigenys sp.* (Pincer jawed).*

*The following Extract from "The Cambridge Natural History, Vol. II.", relating to these ants is of some interest:—"The family Cryptocerini is distinguished by the "antennæ being inserted at the sides of the head where they are placed between ridges "or in a groove into which they can be withdrawn . . . . The species "generally are woodborers, usually perforating the dead branches of trees . . . . . .

In one locality a fair amount of young chupons was observed to be dying back at the tips. This is probably the result of insect attacks, and the larva and two adult specimens of a small longicorn beetle were found in the deadwood. A similar type of beetle (*Decidion socium*) is also responsible for the dying back of melongene shoots, the adult laying its eggs in the epidermal tissue and the grub burrowing up the central pith of the stalk. One chupon showed no trace of insect attack and was at first suspected to be diseased. As there were about 18 inches of green and healthy stalk, die back was suspected but on cutting through the cushion from which the shoot had sprung a greenish (slightly) hairy caterpillar was found, and on rearing this a pyralid moth emerged.

Shade.—The shade tree principally grown in this district is the Bocare or water immortel (*Erythrina velutina*), it is not however suited to the locality and on one estate at least the contractor is bound by his contract paper to plant only the Anauco. Possibly the amount of lime in the soil does not agree with the Bocare and they were frequently met with either dying out or dead especially on the hill slopes. On one fairly sheltered estate near the foot of Mount Tamana, the difference between two adjacent patches, one well-shaded, and the other where the Bocare had died out was very striking; in the former the cacao trees were healthy and vigorous, in the latter miserable looking and evidently dying back.

A stiff reddish and sometimes blue clay is met with at a varying depth in the sub-soil and practical planters state that when the tap root of the cacao encounters this heavy clay, the effect becomes at once visible in the so-called "dying back" of the young shoots. This sub-soil should be analysed.

A. E. Collens,
Scientific Assistant.

25th March, 1909.

93.—Possible yield of Cacao.

On an estate recently visited the proprietor has produced 25 bags per 1,000 from a small plot, and 30 bags from another, and is hopeful of a similar yield on the greater part of his large estate.

The following statement by Mr. A. J. Anderson points to the same result following judicious and intelligent cultivation:—

With further reference to the possible yield of cacao, I have obtained an average yield of 20 bags of 165 lbs. net per 1,000 trees off 30,000 cacao trees. Of these I should say there were 15,000 fairly healthy trees, having had canker removed, and restored, and must have yielded about 25 bags per 1,000 trees, while the remaining 15,000 were kept clean, all new shoots were allowed to mature for 10 years, and they have always yielded an average of 15 bags per thousand.

Here I have 700 trees 6 years old, 900 five years and 900 four years old, which are bearing and were planted and upkept by me personally. From 30th June, 1908 to 31st December these trees have yielded 1,050 lbs. of cured cacao, giving an average of about half-a-pound per tree for six months, and they are now laden with cacao of every size.

94.—Transhipment of Cacao.

With reference to the Table of Exports published in last *Bulletin* (No. 61, p. 9) a correspondent writes as follows:

"As regards the exports of cacao to France I beg to call your attention that the shipments are usually made to Havre with options and are subsequently forwarded from there to other consuming countries in

"The species of Cryptocerus appear to be omnivorous and are frequently attracted by "the excrement of birds . . . . . . In the south of Europe two very minute ants "of the genus Strumigenys and Epitritus belonging to this family are met with under "very large stones, partly embedded in the earth. They are of the greatest rarity."

Europe. * * * This system accounts for the fact that most of the cacao shipped to Europe is apparently going to France, and has to be cleared by the shippers as exported to France. I thought it would be of interest to know this."

95.—Local prices paid for Cacao.

Messrs. George R. Alston & Co. have kindly supplied the following figures covering a period of 18 years.

LOCAL PRICES OF GOOD ORDINARY CACAO.

Year.	*Price per fanega (110 lbs.)*
1891	$13 00
1892	$13 00 to 13 50
1893	14 00 „ 14 50
1894	12 75 „ 11 75
1895	11 75 „ 10 00
1896	10 00 „ 9 00
1897	9 00 „ 16 00
1898	16 00 „ 14 50
1899	14 50 „ 15 25
1900	16 00 „ 14 00
1901	14 00 „ 13 50
1902	13 50 „ 12 00
1903	12 00 „ 13 00
1904	13 00 „ 11 75
1905	11 75 „ 11 00
1906	11 00 „ 19 00
1907	19 00 „ 26 50
1908	18 50 „ 12 00

96.—Canker Treatment.

The Agricultural Inspectors report that some small proprietors apply tar on the surface of the diseased part without first cutting out the canker. This application can be of no use, as the disease goes on spreading underneath where the unhealthy wood is in contact with the healthy wood. The cankered part must first be cut away, and the antiseptic wash applied to the healthy wood.

The implement used in cutting out canker should not be used afterwards on a healthy tree unless in the meantime it has been thoroughly disinfected. Otherwise this implement will spread the disease.

* * * * * *

There are differences of opinion as to whether it is necessary to cut away the last traces of canker when a deep and extensive wound would result. Some think that these traces will be destroyed by the subsequent antiseptic application. Much will depend on the antiseptic employed. A weak solution of copper sulphate might be used before applying the tar.

* * * * * *

Some object to tar in such cases, as it hides the reappearance of canker, and argue that a semi-transparent wash is better, as in a day or two if there is any further growth it is shown by a red spot. A wash composed of cement, lime and sulphate of copper is said to be very much better than tar for this purpose.

97.—Cacao Picking Knife.

An improved knife for picking cacao was shown at the last meeting of the Board. It can be seen at the office at the Red House.

98.—Life and growth of a Cacao pod from its first appearance to the day it got ripe.

The following notes by the Hon'ble C. de Verteuil show that a cacao pod takes nearly half a year in arriving at maturity. During this long period it is exposed to insect and fungus attacks, and the absolute necessity for good sanitation on cacao estates becomes very evident:—

First appearance, 17th July, just emerging from the flower. Size of a pin's head.

On the 15th August, one and three-eighths inches long.
,, 31st ,, three inches long.
,, 16th September, four and one-eighth inches long, and 5 inches in circumference.

On the 1st October, five and one-half inches long, and 7 inches in circumference.

On the 19th October, 7 inches long, and nine and three-quarter inches in circumference.

On the 1st November, 8 inches long, and 13 inches in circumference.

From the 1st November the pod did not grow again. It was ripe on the 6th December.—142 days.

99.—Cacao Beetles.—(Steirastoma).

These boring beetles cause extensive damage especially in young plantations. A planter who has suffered considerably from them writes as follows:

"After experimenting I find that there is only one remedy to be "relied on, and that is to search for, catch and destroy the "enemy with the hand. I have succeeded well in my crusade, "though I have still to continue to destroy the small number "left."

"After felling and burning new lands, I now start catching beetles "even before planting."

100.—Cacao.

Assistance to Inspectors invited.

The earnest attention of small Proprietors is invited to the monthly reports on the visits paid to estates by the Agricultural Inspectors. These Officers have found very few cultivations around Port-of-Spain which are deserving of praise. This is partly owing to the fact that the holdings are very small ones, and that Cacao is in some of them a subsidiary crop to ground provisions. In many instances the owners are not resident on the holdings, and the Inspectors have been unable to confer with them.

In order that the time of the Inspectors may be best utilised, it is strongly recommended that the small planters in any district should agree among themselves to notify either of the Inspectors that they will meet them at an appointed time and place. Or they may ask the Department of Agriculture, or the Wardens of the district, to make the necessary arrangements.

The Inspectors report that very few of the small proprietors keep any account of the yield of cacao for a given area or number of trees. This is a great disadvantage to them, for without this information they are unable to judge whether the cultivation is in a normal condition or not. As an example of the value of these records to the Inspectors, we have the instances quoted by one of them in which the yield from 4,000 trees was only 9 bags, and 9,000 trees giving 90 bags. In the first instance the

Instructor can at once conclude that there is some need of his assistance, in the other that the proprietor is doing as well as can be expected. If the small proprietors will only keep records, however approximate they are, the Inspectors will be better able to help them.

P. CARMODY.

101.—Results of Spraying in Ceylon.

(EXPERIMENT STATION, PARADENIYA.—CACAO SPRAYING.)

Report by the "Tropical Agriculturist."

Since 1902 we have gone in for cutting out excessive shade, excising cankered tissue, and spraying the pods during crop time. As to definite results, these records will show what progress has been made; and you might like to make a note of some of them. The figures I took down are worth noting:—

Month.	*Diseased Pods in 1902, first year.*	*Diseased Pods in 1903, second year.*
July	60 per cent.	4 per cent.
August	62 ,, ,,	3 ,, ,,
September	60 ,, ,,	13·5 *a* ,, ,,
October	34 ,, ,,	22·8 *a* ,, ,,
November	28 ,, ,,	9·3 ,, ,,

During the present, the third year, the fungus pods have varied from ·7 to 1·2 per cent., and the number of diseased trees on the different plots varies from 1 to 10 per cent.

Planters cannot lightly view such facts; and the desire to take up spraying is evidently a growing one.

III.—COCONUTS.

102.—Palmine—A Vegetable Butter.

An article called Palmine vegetable butter has been placed on the market and largely advertised for some time past.

The Department applied for a sample which was kindly sent by the makers.

On arrival it was quite liquid, and consequently could not in this climate be described as a "butter." A cursory examination shows it to be coconut oil which had been very successfully subjected to a process of purification for the purpose of removing rancidity, odor, and all traces of suspended matter. It is likely to sell well as "butter" anywhere except in its native home—the tropics.

The Vegetable Butter Company has a factory in London with an output of from 20,000 to 24,000 tons per annum. About 300,000,000 nuts, principally from Ceylon, are used for this quantity. When Palmine began to be manufactured the copra cost £9 a ton, it is now £28. Any extension in the use of this vegetable butter will benefit our coconut industry. Some Trinidad makers of copra might communicate with the Company.

a. Due to excessive rainfall.

IV.—OTHER FRUITS.

103.—Occurrence of Vanilla in the Peñal District.

In March 1908, I visited a small holding belonging to an East Indian which contained several hundred bearing Vanilla vines.

The holding is situated at the back of Wellington Estate on the Peñal road, the lands immediately around (known as the Debe Settlement) were planted up in beans of some type and rice. This particular spot however was uncultivated, the soil being of a spongy nature and very springy when walked upon; when dried it resembles peat. On excavating a small hole, water immediately oozed in. A small sample brought to the Laboratory, on examination proved to be composed entirely of leaves and rotten vegetation. A special type of terrestial orchid was also abundant. The spot was overgrown with a shrubby kind of tree about ten to fifteen feet high said to be a type of mangrove, and on these trees the Vanilla vines were hanging in festoons. From the regularity of these trees one would suppose that they had been planted by some previous settler for this purpose. The vines were extremely healthy looking and the leaves especially large and green, and at the time of my visit were just about flowering.

The functions of fertilization were described to the owner, and with the aid of a pointed splint he was shown how to remove the pollen masses from the anther and transfer them to the lips of the stigma. After performing the operation several times, he seemed to grasp the principle, but for the want of more opened flowers was unable to try the experiment himself. Mr. Fahey who accompanied me pointed out several young pods, which he had himself fertilized on a previous visit. The area of the spot seemed to be about one quarree ($3\frac{1}{5}$) acres, the owner stated that he sometimes obtained about 100 lbs. of cured pods a year, which he sold in San Fernando at 4 shillings per lb. As he had made no previous attempt at systematic fertilization and only gathered those pods which had been naturally fertilized, this is a remarkably large yield.

A. E. Collens.

June, 1909.

The above report is now published owing to the attention of the Government having been recently drawn to this cultivation by *Mr. Quintin H. Spicer.*

104.—Papaws—A new variety of.

Mr. Caracciolo's introduction of a new variety of this fruit has been an immediate success. The supply at present is not equal to the demand. Visitors to the Colony who have tasted the fruit speak very highly of its delicious taste and flavour.

105.—Grafted Mangoes—Reduction in price.

Orders for these will be booked at the Botanic Stations at St. Clair and Tobago in accordance with the terms of the following advertisement:—

In order to encourage the growth of *grafted mangoes* for the market, the price of plants has been reduced from one dollar to twenty-five cents on orders received within twelve months from date. This reduction applies only to plants *for cultivation in the Colony.*

106.—Cost of export of Oranges and Avocados.

The question of exporting fruit at a profit is the first point to be considered by growers of fruit. There is already a very large production of oranges in this Colony, but they cannot be shipped under present conditions. The following figures have been kindly supplied by a local planter who takes a keen interest in the Fruit Industry.

They show the cost per case of oranges and a loss of ten cents on the transaction.

Avocado pears on the contrary show a considerable profit. This market, though a small one at present, is evidently worthy of attention.

Avocados are now being shipped from Hawaii to San Francisco and New York, and remain sound for three weeks if kept at a temperature of 45° Fahrenheit.

One Case 160 Selected Trinidad Oranges.

Value of Oranges, say	$0	50
Cost of picking, packing, &c.	0	42
Cost of case and paper	0	38
Cartage to Port-of-Spain, say	0	12
Freight per R.M.S. to London	1	20
	$2	62
By sale case, London	2	52
Loss		10
45 Avocados in case as above, cost same ...	$2	62
And sold in London	6	75
Gain	$4	13

As regards Oranges the position is very similar in South Africa, and, until freight charges are considerably reduced here, there seems no probability that Citrus fruits from distant colonies can compete successfully in the home market. It will be observed that the sea freight from Trinidad to London is 5/-, while the rail and sea freight from the Transvaal to London is less than half that amount.

107.—Cost of Export of Citrus Fruits from South Africa.

(*Journal of Agriculture, Cape Colony.*)

A step has been taken in the right direction in connection with this budding industry. That it was possible to make this progress is due primarily to the Government policy of encouraging exports and the hearty co-operation of the Central South African Railways.

A comparison of the expenses attached to the shipment oversea of these fruits incurred last year and this, is interesting.

As against £2 15s. per ton, freight from Pretoria to Durban, the railage this year was reduced to 15s. per short ton between Pretoria and any South African port. Capetown was selected on account of the saving of time during transit. Sea freight was not reduced, remaining as previously 25s. per cubic ton.

Boxes which cost last year 1s. 8d. each, were procurable in Pretoria at 1s. 1d. This reduction was rendered possible by the action of this Department in purchasing a large quantity by tender. Under these two headings therefore, a very substantial saving was effected.

OTHER FRUITS.—*Continued.*

Estimates made as carefully as possible showed that the cost of sending a box of oranges from any station in the Transvaal to London worked out at approximately 4s., taking the following figures:—

	s.	d.
Rail and Sea freight, and Dock dues	2	3
Paper for wrapping	0	3
Box	1	1
Nails	0	1
Strap iron	0	2
Insurance	0	$0\frac{1}{2}$
	3	$10\frac{1}{2}$

These figures for freight were arrived at on a basis of allowing 70 lbs. as being the weight of a box of oranges. As a matter of fact the boxes were frequently heavier, so that the actual cost of freight by sea and rail, together with dock dues and insurance, worked out at 2s. 4d. per box. Taking the first six shipments from four different consignors I find that the fruit realized on an average less than 4s. per box; after deducting all expenses save picking, hauling, and packing at this end, this means about 2s. 6d. per 100, a figure that cannot offer much inducement to continued efforts in the direction of building up a large citrus export trade, and it must be remembered that the figures from which these deductions have been obtained are those which prevailed during the earlier part of the shipping season, when prices were at the best. Had the latest prices realized been included in the calculations, it is a fact that even lower figures would have been reached, for our later shipments came into competition with West Indian fruit.

An examination of the different items of expenditure reveals the fact that there are only two on which any reduction is possible; these are sea freights and box material.

Looking at the former, it would strike the intelligent observer that it would be policy on the part of the Union-Castle Steamship Company, to make a substantial concession in the matter of rates, if only in the interest of their shareholders. The question is a simple one. With a rate of 15s. a certain number of tons of fruit can be removed annually from Transvaal to Europe at present, with the prospect of a very large increase in a few years' time; will it pay the Steamship Company to handle it? Taking into consideration that this class of goods is carried in the ventilated parts of the hold, that freight from South Africa to London is nearly always scarce, excepting when mealies go forward, one would think that it would be as well to take 15s. per ton and look for profit in the quantity to be dealt with, but I recognise that it is difficult for a layman to discuss such matters as these.

The situation as it appears to me is that with such a concession in sea freight, the possibilities of building up a large export trade are good, without it I could hardly advise extended planting of citrus fruits amongst our farmers. It might be possible to secure a profitable market for more choice goods than we have at present, but that would be a matter of time, years in any case, and the development of such an export business as is possible would not materialize. In the case of boxes, the present price is still too high. The box used this season cost 6d. in Sweden, and on arrival in Pretoria 1s. 1d.; the increase in value is arrived at approximately after the following fashion. Railage, Delagoa Bay to Pretoria, 2s. $10\frac{1}{2}$d. per 100 lbs.; $2\frac{7}{8}$d. per box, duty, 15 per cent.; $\frac{1}{2}$d. sea freight; $1\frac{5}{8}$d. agent's profit; and landing charges $1\frac{1}{2}$d.

It is palpable that the rail charges are excessive; they amount to almost 50 per cent. on the original cost of the box.

V.—GENERAL FORESTRY.

108.—Honduras Mahogany.

(*Swietenia macrophylla*).

In view of the increasing local interest in re-afforestation generally, and especially in the planting of Honduras Mahogany, a large quantity of the seeds (179,000) of this tree is being obtained from British Honduras, and it is hoped that the following notes will aid those who are taking up the cultivation of this valuable timber.

An argument often used against the planting of timber trees is, the length of time before a return is obtained; but it should be remembered that on every estate there are portions of uncultivated land, and it is surely better to plant some useful tree than to allow that land to remain idle.

A great advantage of timber cultivation is that after the initial work of planting there is no expense to incur beyond an occasional brushing.

Honduras Mahogany will grow in comparatively poor soil, and may be planted on lands where Cacao or Rubber will not thrive. It may also be planted along estate boundaries and affords an effective windbreak if planted together with the common Mango (*Mangifera indica*) or the Cashew (*Anacardium occidentale*).

A fine example of a Mahogany and Mango windbreak may be seen at the Tobago Botanic Station.

The close planting system is recommended when planting by the block in quantities, as it encourages the development of the straight trunks so essential in timber trees.

Under average conditions 10 ft. x 10 ft. is a good distance to plant and subsequently trees may be thinned out when and where necessary. The trees cut out may be used as fencing posts, and will pay for the work of thinning.

Applications for 101,000 seeds and 7,775 plants have already been received.

Raising Plants from Seeds.

It is important that the seeds be sown when fresh, as if kept for any length of time they lose their germinating power.

Small boxes with a few holes in the bottom should be used, the handiest size is 16″ × 12″ × 4″—(Milk boxes cut in half answer very well). Place a layer of small stones for drainage at the bottom, and then fill the box three parts full with a compost consisting of equal parts well sifted leaf-mould and loam. Press the soil firmly and spread the seeds thinly on the surface and then cover with a thin layer of soil.

The boxes should then be placed in a well shaded position and carefully watered, and it must be borne in mind that seeds are destroyed equally as much by over-watering as by drought.

When from six to eight inches high the seedlings may be potted out into bamboo pots, and in six to eight months they will be fit to plant in the open ground.

When seed boxes are not available the seeds may be sown in nursery beds. The beds should be well forked and raked and the soil made fine and small.

The seeds should then be scattered thinly over the surface and covered with a very thin layer of well sifted soil, a good watering may then be given and the beds covered with palm leaves as a protection against the sun and heavy rains.

F. Evans.

Mr. C. S. Rogers, Forest Officer, has kindly supplied the following information with regard to the sowing of Mahogany seeds :—

HINTS ON SOWING MAHOGANY SEEDS.

Selection of Nursery.—The area on which the nursery is to be made should be central (unless required elsewhere for purposes of supervision) with reference to the area to be planted in order to save subsequent cost of carriage of the young plants. It should preferably be level.

Soil.—The soil should be similar to that on the area to be planted, as though the seedlings might be larger and stronger in a given time if grown on a rich soil, they would quickly lose this advantage if planted out on a materially poorer soil.

Surroundings of Nursery.—Protection from wind is advisable but shade to a large extent is not required therefore the nursery should not be overshaded by large trees whose roots would also probably overrun the nursery.

Seed Beds.—The seed beds should not be more than two feet wide in order to facilitate weeding and should have a space the same width between them. If the nursery is on sloping ground the seed beds should run horizontally following contours, this will prevent damage by washing out during heavy rain. Beds may be of any required length ; it is convenient to have them not more than 20 or 30 feet long to facilitate access.

Preparation of Seed Beds.—The soil should be well pulverised, it is sufficient to cultivate the soil to a depth of 6 or 8 inches to avoid the development of a long tap root which would be liable to injury during transplanting. The height of the beds should not exceed six inches, otherwise the earth is liable to be washed away during heavy rain together with the seeds.

Sowing the Seeds.—The seeds are best sown two inches apart and laid flat in lines one foot apart across the beds, as weeding is then easy. A good general rule is to cover the seeds with a depth of fine soil equal to their thickness. It is as well in the case of winged seeds like mahogany to rub off the wings before sowing, this can easily be done by lightly rubbing them together in a bag.

Shelter for the Seed Beds.—If the seeds are to be sown at the time of heavy rain it is advisable to erect a light shelter over the seed beds ; such shelter can be composed of a layer of palm leaves on a framework supported by posts at a height of 6 feet from the ground, sufficiently open to admit of some light, but close enough to break the force of heavy rain. When the seedlings are 2 or 3 inches high this shelter should be removed.

Germination of Seeds.—Honduras Mahogany seeds take 10 days to a fortnight to germinate as a rule though some of them may take 3 weeks or even longer.

Watering.—Unless rain falls soon after the seeds are planted, a light watering should be given and repeated every day or two till the seeds have germinated. In showery weather watering may be omitted. After the seeds have germinated watering should be stopped, for although a larger number of plants might be obtained from a given number of seeds if watering were continued, they would not be as strong and hardy as if left to take their chance under natural conditions whereby the weaker plants would be weeded out and much cost of subsequent supplying the plantation would be avoided.

Transplanting.—When the plants are 6 inches high they may be either pricked out into nursery lines in beds, the plants being one foot apart and the lines 2 feet. As an alternative they may be pricked out into bamboo pots but should not be kept more than a few months in these as the roots are cramped and placed in an unnatural position, tending to produce shrubby plants.

C. S. ROGERS,
Forest Officer.

VI.—RUBBER.

109.—Artificial Rubber.

The progress of the attempts that are being made to produce an artificial rubber must always be of interest to Rubber planters.

Recently a patent has been applied for in Trinidad as well as in other countries; and it is claimed that the material has physical and chemical properties similar to Para Rubber. The inventors are Mr. John Blum, Doctor of Chemistry, Brussels, and Mr. A. W. Carpenter, Banker, London.

The process consists in subjecting peat or similar vegetable matter, mixed with water, to fermentation until a mucilaginous mass is formed consisting mainly of isoprene, and to this mass is added a nitrogenous derivative of irone, and small quantities of a mineral salt.

The irone is obtained from the root-stock of plants of the Iris family, the water solution of which is treated with chlorine to form a hydrochloride of irone which is then converted into a nitrogenous compound by the addition of a suitable substance, preferably an amide. Mineral salts are then added, preferably a mixture of sodium bicarbonate and chalk, and the resulting brown powder is separated by filtration.

110.—Rubber from Tobago.

An excellent sample of rubber prepared by a new process was shown at the May meeting of the Board. It excited considerable interest.

The centrifugal machine with which it was prepared has been patented, and will soon be in the market. It is claimed for this machine that it will produce clean sheet rubber within half an hour of collecting the latex.

111.—Guayule Rubber. I.

(*Journal of Industrial and Engineering Chemistry.*)

This rubber bearing plant differs so greatly from others, and has been so much in the public eye in recent years that the following extract should be interesting:—

It has long been known that the natives of Mexico in some of their games use balls composed of an elastic substance which they obtain by chewing the bark of a shrub called Guayule. Attempts have been made from time to time to introduce this substance industrially, but without success until recently. The first practical experimentation on a commercial scale seems to have been made in 1903–4. In the following year the product, which has been found to be a true rubber, began to be put on the market. From this time on the industry developed with extraordinary rapidity, and the excitement in Northern Mexico is said to have been comparable to that in Texas when the oil fields were discovered. By 1906 practically all the Guayule within reach of existing transportation facilities was contracted for.

The Guayule, *Parthenium argentatum*, is found on the semi-arid lands of the plateau of Northern Mexico, growing in the dry, rocky soil of the foot hills. It is not large, the dimensions of plants of factory size are approximately as follows:—

Height.	*Dry Weight.*	*Diameter at base of trunk.*
12 inches	6 ounces	$\frac{3}{4}$ inches.
20 ,,	12 ,,	$1\frac{1}{8}$,,
36 ,,	32 ,,	$2\frac{1}{4}$,,

The average weight of factory shrub is probably between 12 and 16 ounces. The plant shown in the cut is an exceptionally large one, weighing $5\frac{3}{4}$ lbs. It was $44\frac{1}{2}$ inches high and $2\frac{1}{4}$ inches in diameter at the ground level.

The shrub is collected by pulling up the entire plant, and is pressed either in the field or at the railway station into bales weighing from 80 to 100 kilos. In 1904 these are said to have brought 7 pesos per ton; in 1905 the price had risen to 30 or 40 pesos, and recently has been above 100 pesos. (1 peso equal to $0.50 gold).

The guayule contains in the neighbourhood of nine per cent. of pure rubber, calculated to the perfectly dried plant. The methods that may be used to extract the crude rubber are entirely different from those used with most rubber plants. These contain a milky juice or latex from which the rubber is obtained by coagulation, while in the guayule the rubber exists as such preformed in the plant. The earlier processes were of three types: (1) the alkali process in which the shrub was boiled with a solution of caustic alkali; (2) the solution processes in which the rubber was extracted by carbon bisulphide or some other solvent; and (3) the mechanical process. The first of these is still used in apparently only one factory. According to the patent specifications, the ground shrub is boiled with three times its weight of 6 per cent. caustic soda for 6 hours, after which the rubber is skimmed off and freed from alkali. Of the second class the carbon bisulphide method has been abandoned, because of the expense and the belief that rubber when recovered from a solvent does not possess certain desirable physical qualities to the same degree as an undissolved rubber. A process that belongs to this type has been extensively experimented with in a new factory during the past two years. This process is said to be based on the extraction of the dried shrub with benzol. A solution of rubber and resin is obtained from which the former is precipitated by the addition of alcohol. It has been prophesied that this process will prove a failure for the same reasons that have led to the abandonment of the bisulphide extraction, but the product is now on the New York market and the outcome is awaited with interest. Rubber produced in this way should run lower in resin than that obtained directly by the other processes. The great bulk of the guayule rubber now coming into the market is obtained by the third, the mechanical process. In this the shrub is crushed and then ground with water in pebble mills. The rubber in the plant then becomes apparent as small particles at $\frac{1}{16}$ inch in diameter and from $\frac{1}{16}$ to $\frac{1}{8}$ inch long. The details of the succeeding operations to separate the rubber from the woody matter are for the most part kept secret and doubtless vary in different factories, but it may be said in a general way that the procedure is based on the fact that when soaked with water the woody fibre becomes water-logged and sinks while the rubber being lighter than water floats on the surface of the tanks and is skimmed off. It is then washed, sheeted on steel rolls, and either shipped moist or first dried by hanging the sheets in an airy room or by heating gently in a vacuum. If the mechanical process is properly conducted, a practically complete extraction of the rubber from the shrub is secured.

Guayule rubber obtained by the mechanical process is black on the surface when it reaches the market, but olive to light brown within. The dry crude rubber contains about 20 per cent. resin. Some factories also produce a brand from which the resin has been in great part extracted, but the demand for this seems comparatively small. Guayule rubber softens more quickly on the rolls than most other rubbers and therefore requires to be handled somewhat differently, but once this is understood, the working of guayule rubber of good quality presents no difficulty. It can be substituted for many of the African rubbers, is used to advantage in boots and shoes and many other lines of manufacturing, and seems to be growing in favour. The Guayule rubber recently reported as received at the port of New York was, September 850,000 lbs., October 929,500 lbs. November 1,444,000 lbs.

112.—Guayule Rubber II.

DISTRIBUTION OF RUBBER IN DIFFERENT PARTS OF THE SHRUB.

* * * * * *

In connection with a study of the chemistry of Guayule, the question of the distribution of rubber in the different parts of the plant has been taken up. The results have turned out to be unexpectedly interesting, and to present problems of technical importance. The material consisted of air-dried plants of different size, selected so as to represent approximately the ordinary run of factory shrub, viz. :—

	Height.	*Weight.*	*Trunk.*	*Root.*	*Branches and Leaves.*
1. Large plant	3 ft.	944 g.	165 g.	125 g.	654 g.
2. Medium plants	2½ ,,	747 g.	165 g.	132 g.	450 g.
5. Small plants	2 ,,	2,101 g.	637 g.	272 g.	1,192 g.
Totals		3,792 g.	967 g.	529 g.	2,296 g.

In the division of material the main stem up to the point where its diameter was that of its largest branch was called trunk. The largest branches were less than one-half inch in diameter. The plants had lost most of the leaves in shipment, as is usual, so that the value for "branches and leaves" is practically that of the branches.

* * * * * *

RESULTS OF ANALYSES.

Material.	*Per cent Rubber.*	*Average.*
Trunk bark	21·2, 21·1, 22·7, 21·8, 19·6, 22·9, 22·2, 19·7, 21·4, 20·3, 22·4	21·4
Root bark	... ...	19·8
Branches and Leaves	... ...	9·1
Trunk wood	... ...	0·04
Root wood	... ...	1·8

* * * * * *

The amount of rubber contained in different parts of the Guayule :—

	Dry weight Gram.	*Rubber per cent.*	*Weight of Rubber, Gram.*
Trunk bark	349	21·4	74·7
Root bark	127	19·5	24·8
Branches and leaves	1,918	9·7	186·0
Trunk wood	404	0·0	0·0
Root wood	255	2·0	5·1
Totals	3,053		290·6

The percentage of pure rubber in the whole trunk is 9·9, the whole root 7·8, the branches and leaves 9·7, and in the whole plant 9·5. These figures are based on perfectly dry material.

* * * * * *

RATIO OF BARK TO WOOD IN GUAYULE.

Now that it has been definitely established that the trunk wood of Guayule contains no rubber the question of the ratio of bark to wood in the plant acquires importance. Inspection of the material prepared for analysis shows that the trunks of the shrub are made up of 46·4 per cent. bark and 53·6 per cent. wood.

* * * * * *

To determine the per cent. of bark in the plant as a whole, two plants weighing 235 grams and 152 grams, were steamed, debarked separately, and the parts dried and weighed. The plants contained 54·6 per cent., and 57·8 per cent. bark respectively. If the mechanical diffi-

culties could be overcome, an efficient decorticating device therefore would make it possible to nearly cut in two the amount of raw material handled in the mechanical process without diminishing the yield of rubber.

113.—Extractives from Guayule (Parthenium argentatum).

(*The Journal of Industrial and Engineering Chemistry, May, 1909.*)

This is a record of work done with guayule, plant and rubber, in January, 1906.

The samples as received comprised a stalk of guayule about two feet high, about a pound of comminuted plant resembling coarse saw-dust, and a small sample of rubber produced commercially by mechanical means.

The moisture found was 4·5 per cent.

Another portion was burned for ash, and yielded 3·56 per cent. Of the ash 61·0 per cent. was calcium carbonate.

Another portion was extracted with acetone in a Soxhlet extractor, The product, after evaporating the acetone and drying at 105 degrees. amounted to 9·57 per cent.; this product was saponified with alcoholic potash. On separating the saponifiable from the unsaponifiable, the fatty and resin acids amounted to 3 per cent. of the weight of the wood. The unsaponifiable was 2·2 per cent. of the wood.

The discrepancy between the 9·57 per cent. taken and the 5·2 per cent. recovered was due in part to the fact that part of the original extract was water-soluble and another part volatile.

On the same portion which had been extracted by acetone and after drying the same, an extraction was made with benzol. From the benzol extract the "rubber" was precipitated with a large quantity of alcohol. After drying, this product weighed 5·04 per cent. This should not be taken as the total rubber in the sample, for unless the cell walls are ruptured it is not to be supposed that the rubber solution can pass out.

This ended the work on the wood. A portion of the guayule rubber as produced by mechanical means was dissolved in benzol and the rubber precipitated by alcohol. The yield was something like 45 per cent. I have mislaid the figures.

It is undoubtedly the presence of a large quantity of resinous matter associated with the rubber that enables the extractives to collect together as the wood is ground under water. The ground wood floats off and the rubber gradually collects as one mass under the roller.

Is there not a hint in this for the collection of the rubber contents of the milkweed* ? The rubber from the latter is of far finer quality than the guayule product, which would hardly be used were it not for the high price of the real rubbers of commerce.

114.—Packing Para rubber seed for export.

(*United States Experiment Station Record, April, 1909.*)

The Botanic Gardens at Singapore have been highly successful in exporting large quantities of Para rubber seed packed in burnt rice husk. A layer of burnt rice husk is put in the bottom of a tin box and alternate

* Asclepias sp.—Allied to the common red head or wild ipecacuanha so common in pastures.

layers of seed and husk are added until the box is full. The rice husk is slightly moistened before packing to keep the seeds in a fresh state. The box is not soldered for fear of excessive moisture collecting inside.

Of 10,800 Para seeds packed in this manner and shipped to British Guiana, 64·4 per cent. germinated after being packed a little over 53 days. A much larger similar shipment later on gave a germination of approximately 80 per cent.

115.—A root disease of Para rubber trees.

(*United States Experiment Station Record, April, 1909.*)

THE author reports the rather common occurrence throughout the Malay Peninsula of a fungus which attacks the roots of the Para rubber trees (Hevea brasiliensis). The disease is seldom distributed over an entire estate, but is confined to limited areas which appear to serve for centres for its distribution.

The presence of the disease is not usually noticed until the tree is dead. The first symptoms are observed in the leaves becoming brown about the edges, and the entire leaf soon loses its natural colour. Little or no latex will flow from the wounds in the stem, and later the trees are blown down. This is apparently due to the destruction of the lateral roots of the trees. So far as the author has observed, the attack seems to be in the more superficial lateral roots, and on different occasions he has traced the mycelia of the fungus along the lateral roots to decaying jungle stumps.

Thus far, owing to a lack of fruiting bodies, the identification of the fungus has been impossible, but it is believed to be one of the higher fungi similar to the bracket fungi. As remedial measures, the author suggests trenching about trees and destroying the fungus by exposure to the sun and the application of lime.

VII.—CEREALS AND STARCHES.

116.—Rice Returns in British Guiana.

(*Journal of the Board of Agriculture, British Guiana.*)

From a return just published, the yield of paddy per acre in bags of 120 lbs. for a single crop varied from 34 to 17 with an average yield of 21 and 23 bags in the Counties of Demerara and Berbice respectively. The total crop amounted to 962,679 bags from 37,851 acres.

117.—Starch.—To rival the Banana.

(*Daily Mail.*)

MR. C. C. MOORE, of the Department of Agriculture of the United States, has been in Jamaica for some weeks studying the cassava. Mr. Moore besides being attached to the Government bureau, represents large financial interests. The proposal, it is understood, is to have the cassava rival the banana. It is proposed to plant nearly the whole of three parishes on the south side of the island with cassava, and to erect factories for the manufacture of cassava starch, denatured alcohol, and cattle feed. There will be three factories, having a total capacity of 500 tons of starch per day. The capital of the company runs into millions. Already the local Government has lent its support to the scheme.

(NOTE.—A great deal of attention has recently been paid to cassava as a source of starch. Yields of cassava from 13,000 to 15,000 lbs. per acre have been obtained in other West Indian Colonies.)

VIII.—COTTON AND OTHER FIBRES.

118.—Tobago Cotton.

Six bales of Tobago Cotton—the first shipment of the 1908-9 crop—were valued at 15d. to 15½d., but subsequently sold at 17d. per pound. This was the highest price paid during the fortnight. It is stated that it was purchased at this higher price by a French Manufacturer on account of its superior fineness and length of fibre.

IX—SOILS.

119.—The Maintenance of Soil Fertility.

This is the most pressing problem which the Trinidad Planter has to face at the present time. On Sugar Estates, it has been impossible to disregard it, because neglect, for a year or two, would mean so large a diminution in the crop that the results would be serious. On established Cacao Estates, until recently, very little has been done in this direction; because the yield diminishes imperceptibly, and is subject to seasonal variations which mislead the average planter. On Estates partially established, which are so common here, it is impossible to make an accurate estimate owing to the variation caused by the addition of young trees coming into bearing year after year, the latter upsetting all attempts at calculation. On lands cultivated for yearly crops of ground provision, the practice is painfully casual. A few acres are rented, and when they cease to be remunerative the tenant goes elsewhere. For the present this is possible, but the time will come in the near future when it will not be so. Then the question of maintenance of soil fertility will be as important to him as it has been to his confreres in other countries.

Wherever virgin lands are unobtainable, or wherever land is of so much value that it cannot be allowed to grow into bush for 5 or 6 years, the problem of the maintenance of soil fertility has always to be *seriously* considered. There is in this Colony a possibility yet of allowing lands near the larger centres of population to lie fallow for a few years, then to burn the bush, and get a crop of maize, or sweet potatoes from the potash produced by burning. Near San Juan this practice is now to be seen. The lands have been abandoned for some years, and were overgrown with bush 6 or 8 feet high. Within the last two years a large area of this land has been cleared and burned, a crop or two will be raised, and the land will probably be again abandoned for the usual interval of 5 or 6 years. There is no attempt made to maintain the fertility of the soil in these small holdings. This is the primitive method of cultivation practised by the uncivilised inhabitants of all countries. Land so near Port-of-Spain should be utilised as market gardens, and such land if properly worked could be very profitably cultivated every year.

On small cacao estates, and on some large ones, there is similarly no attempt made to maintain the fertility of the soil. Care is usually taken to select land with good natural fertility, and such land produces yields varying in proportion to the degree of its natural fertility. The natural fertility of average cacao lands in this Colony is represented by an approximate yield of 10 bags (of 165 lbs.) per 1,000 trees. If cultivation is neglected, this yield cannot be obtained for many years as cacao steadily removes a large quantity of mineral food from the soil, and this is not completely replaced fast enough by the natural agencies at work in the conversion of dormant into available plant food. Additional losses are caused by the heavy tropical rains, which remove soluble plant food and the fine soil which is so much more valuable that the coarser particles that

are too heavy to be washed away. These annual withdrawals can in part be estimated. It is known for instance that 10 bags of cacao remove from the soil

Lime	3·5 lbs.
Magnesia...	10·5 ,,
Potash	17·5 ,,
Phosphoric Acid	21·2 ,,
Nitrogen...	30 ,,

The amount removed by soil washing is very variable and cannot be even approximately estimated.

The nett result is however, that the soil is poorer in available plant food because of these losses, and the yield of cacao diminishes in proportion.

Continuous successful farming depends on the maintenance of soil fertility; and if planters in this Colony wish to obtain a regular yield of even 10 bags per 1,000 trees they must do something more than they do at present in maintaining the fertility of the soil. It is not only diminishing yields that must be expected. Diseases are sure to follow. They have invariably followed every kind of cultivation when the requirements of soil fertility have not been maintained. Diseases from this source are of an overwhelming nature. They sweep out whole cultivations. Trinidad had such an experience with cacao in 1727. It may not occur again because of the marked revival of interest in all that pertains to cacao cultivation that has taken place within the last year or two. This revival should continue until the question of the maintenance of fertility is regularly practised.

The methods of the maintenance of fertility may be described under two heads, viz., mechanical and manurial. In modern methods of cultivation both are necessary; but wherever intensive cultivation is practised the latter assumes a predominant part and will be dealt with first because it has been neglected more.

For cacao cultivation especially mineral manures must be applied to the soil. The 50,000 tons of sugar exported from the Colony do not carry away more than a few *pounds* of mineral matter because pure sugar is composed solely of substances that are obtained from air and water. The small quantity of mineral matter in sugar as exported is a negligible amount. Cacao on the contrary carries away large quantities from the soil and this requires to be replaced. For many years cacao has been cultivated without any attempts being made to replace this plant food; and the losses have thus accumulated to such an extent that yields are already diminishing in many districts, and will continue to do so until the debt the planter owes to the soil is paid off.

Although mechanical means are capable of restoring fertility to the soil, the process is a slow one. In consequence of this the use of manures becomes necessary. Of the three principal manures—nitrogen, potash, and phosphates—the first is the most costly. And because of this more attention is paid to it. The principal sources of nitrogen in the form of manures are nitrate of soda, and sulphate of ammonia, and these are quoted at from £10 to £12 a ton. The possibility of the exhaustion of the nitrate beds in Chili—the only source—has given rise to some alarm in recent years, and Chemists, anticipating this, have looked for other sources of nitrogen. The air contains immense quantities of it, but it must be changed into something else before it becomes available as a manure. Although the nitrogen in the air costs nothing, its conversion into a direct plant food is a difficult and therefore expensive process; and on account of this the new product is at present no cheaper than nitrate. So difficult is the process of conversion, that it is only by the employment of natural sources of power, such as waterfalls, that the cost of production is kept sufficiently low to enable the new artificial manure to compete with

the nitrate. Accordingly we find that wherever there are large waterfalls conveniently situated, immense factories have been erected (and are being already extended), for the production of electricity with which to heat electric furnaces wherein the nitrogen is forced into combination with lime, and the new manures known as Calcium cyanamide and Calcium nitrate are thus obtained. It is certain that the cost of production will be reduced when the output is increased, and so at the present time it is certain that the future exhaustion of the nitrate beds need not give rise to any anxiety.

The high cost of nitrogen has forced farmers to search for cheaper sources. This has resulted in the utilization of the nitrogen stored in the nodules of the roots of leguminous crops, in artificial means for the production of nitrogen bacteria, in mulching and other expedients for obtaining supplies of nitrogen. Experiments have shown that the supplies obtained from leguminous crops are by no means inconsiderable in amount. This has been proved here in the case of the flowers of the Immortelle trees which contribute 24 lbs. per acre. The total amount in the nodules on the roots of the same trees has not yet been ascertained, although the proportion of nitrogen in these nodules has been shown to amount to over 4 per cent. (*see* Bulletin No. 61, p. 12). In other countries crimson clover, velvet beans, have been shown to add in a year no less than about 200 lbs. per acre which if bought in the form of manure would cost about $30.

P. Carmody.

(*To be continued.*)

120.—The Natural Regeneration of Worn out Cocoa Soils.

(*Read at the meeting of the Board, 23rd April, 1909.*)

That this is a question which deserves the close attention of every cocoa planter is evidenced by the fact that there are few estates—if any —in the Island which do not exhibit a certain, sometimes considerable area of their full grown cultivation in a worn out condition or on the high road to it. They are a familiar sight on cocoa estates, these patches, "in a more or less advanced state of degeneration, which may correctly be termed worn out" from the fact that the stumps and struggling remnants of cocoa trees standing on them show all the signs of having flourished at one time under the best conditions, without which they could never have attained so full a trunk growth; and they too often remain a familiar sight until they finally drop out of existence altogether into vermin breeding patches of bush standing as an eyesore in the midst of good cultivation. Many a planter will tell you that the regeneration of these barren spots is the most difficult undertaking you could attempt in the cocoa planting line except at an unjustifiable cost, and probably the concensus of opinion would be that it is better and cheaper in every way to let it go and plant up more new land if you have it.

The causes which have brought about this worn out condition of once flourishing cocoa fields are difficult to nail down hard and fast, in fact are often so obscure as to admit only of conjectural explanation on account of the backward process being usually a slow one extending over a good many years, and the whole history of the field and its treatment not always being in the hands of the owner, but in such cases a good conjectural explanation is a fairly safe basis to go upon, and the causes do not so much affect the regeneration as they do the checking of a similar condition elsewhere when the problem is in the proverbial "stitch in time" stage. Nevertheless, a fair conjecture at a probable sequence of conditions which may have caused the degeneration is distinctly *apropos.*

Bearing in mind that cocoa cultivation is raised in Trinidad under the Bois Immortel from infancy to maturity, and that the present ideal of good cultivation is an even covering of these trees over the cocoa so that in combination with the leafy heads of the cocoa trees, the surface of the soil is so evenly shaded as to practically prevent any kind of undergrowth, while the most effective of all possible forms of wind-break is thus given to the soil and cocoa trees: it will be seen that the fertility of the soil is in the long run dependent upon the continuance of this condition, and for all practical purposes might be stated shortly as the difference betweeen the amount of plant food taken from the soil by the crop removed and the amount returned to it by the cast leaves, flowers, branches, prunings, etc. from the Immortel and cocoa trees, plus—of course—the mineral reserve in the soil, the organic addition from the under-brush being hardly worth considering under such circumstances. There can be little doubt that with such crops as are removed from cultivation of the sort (in Trinidad), the balance is in favour of continual, or at all events, sufficient fertility for the maintenance of a healthy cultivation, because the organic matter returned is in excess of that removed by the crop, and the mineral reserve in the soil is usually more than sufficient to make good the practically insignificant amount of ash removed yearly by the crop. Under a well covered cultivation of this kind the only ingredients of fertility actually lost to the soil are the *minerals* which form the ash of the crop and the living trees standing on the soil, the amount carried off by drainage not being serious—probably not worth considering,—but although this loss estimated yearly makes little impression on the reserve in the soil, it becomes of importance in soil which has been cropped steadily for forty years or more, and it will readily be appreciated that if any unusual elements of leakage have been allowed to creep in, *the depleting processes will get ahead of those which produce an available supply from the reserve, and infertility on account of unavailable minerals result,* while the soil may still be rich in an insoluble store. In other words the mineral fertility hangs on the available supply, and as the available supply is dependent largely on the presence and action of the humus, the reduction or depletion of the organic matter is the primary cause of infertility in most barren cocoa soils. When, therefore, it is remembered that the humus is the most unstable ingredient in the soil and that its loss by decomposition goes on and continues as long as there is any to decompose irrespective of any cultivation, it becomes still more apparent that the fertility of our old *un-manured* cocoa soils is simply a question of the balance already referred to being kept up.

A lot of small leakages can make a big loss in the aggregate. For example, what might be described as the thin edge of the wedge in the slow but steady degeneration is the common practice of always making the heaps of pods in the same spots in the fields, when, as is often the case, the shells are either allowed to rot into the soil *in situ*, or limed and spread in the immediate vicinity from one year to another. This is a flagrant example of upsetting the balance and enriching one area at the expense of another, and yet it is a staring fact which seems to be missed by many planters. This item of leakage is particularly marked on hilly or undulating estates where the heaps are generally broken on the flat spots, and the decomposed shells rarely spread again where they properly belong. A weakening of the balance of fertility always affects the Immortels first,—these trees being a living contradiction of the wonderful faculty of the Leguminosae for thriving upon soils poor in nitrogen, or humus,—they lose their vigour and become a prey to the attacks of parasitic fungi which find easy entry through the innumerable wounds the trees receive at every cutlassing, and begin to die, very often coming down with a good full head while they are quite rotten at the base. The fall of one of these giants generally upsets any weaker ones alongside, or at least

administers a good, heavy trimming of a rough-and-ready order, not to speak of the devastation below, and another link in the chain is forged.

Quite a new condition of affairs is immediately set up, the hitherto bare surface of the soil bursts out with a vigorous growth of seedling weeds, and the general appearance of the mutilated area is more like what would be expected from a good strong tonic than the results of a disaster. Just here is where the stitch in time would go a long way to save the situation, for nature makes violent efforts to fill the gap, and the immediate supplying of the Immortels and some temporary covering, such as bananas, and the careful pruning and tarring of the broken trees very soon restores the balance. In that particular area the Biological and Chemical actions in the soil, and the vital forces of growth become rampant, the resulting fertility only requiring to be directed into the proper plants, while the rotting carcase of the Immortel and general plant refuse are a fund of ready manure. If neglected, however, the spot goes from bad to worse as the influence of weathering goes on, particularly if that most pernicious of all systems on cocoa estates—*the cutting of fodder for stock in the cocoa fields*—is permitted. The open spot is the grass-cutter's Eldorado, for he can fill the stable with a few sweeps of his cutlass while it seems to grow almost as fast as he can cut it, and galloping consumption of the soil is the result. It is not pretended that the sequence of events taken here as an illustration are the only or even usual cause of barren spots, but wherever such practices are allowed it is within the scope of any observer to see them operate very efficiently as such, whatever the cause, these barren spots are an institution on many cocoa estates, and their regeneration, if possible, on practical and inexpensive lines is worth considering.

Taking the finished product as an example to deal with it would indeed appear a hopeless task, particularly if it has been handled for several years in the manner indicated. No longer capable of growing bush for stock fodder and bedding, it has settled down to a thin growth of hardy grasses and weeds which the misguided planter periodically weeds with a hoe as bare as a backyard, while he has despairing allowed whatever hardy wild trees will grow to come up and provide the much needed shade, or has stuck it full of the wild chestnut. The surface of the soil has lost the black look and become a light brown or red colour, is caked and almost as hard as a subsoil pan, and in dry season opens up in long cracks and innumerable fissures. What cocoa trees survive and it is astonishing how many do—are standing monuments of the hardihood of the cocoa plant, consisting usually of a gnarled and scrubby trunk with a few weak branches which are constantly changing a few leaves, and as constantly dying back again, while even the wild trees growing up around look mean. There is little wonder the planter grudges the expense of keeping it clean and lets it go to bush. What has happened is of course apparent. The soil has been depleted of its humus and available mineral matters by these wasteful processes in combination with the biological and chemical actions broadly recognised under the term "Nitrification," the resulting products instead of being captured and returned to the soil with interest as plant refuse being bodily carried off or gradually removed by drainage. The physical and mechanical effects of this loss of humus upon the soil are part and parcel of the wholesale degeneration, and might graphically be likened to dissolving out the frame of a house and letting the whole structure descend in a suffocating mass on the inmates. The humus is the spongy frame which is responsible for the whole motive power of a soil factory without which it is not soil, but simply land or ground, and in the absence of any kind of tillage which is usually the case in ordinary cocoa cultivation, where it not for some of the wonderful natural forces—one particularly of which will be mentioned later—which distribute the organic matter

from the top through the deeper layers of the soil, even a heavy surface coating would not produce a truly fertile soil.

There is no hope for the barren spot therefore, unless we can restore the humus, and of course the most rapid and sure method would be to fork in heavy applications of farm-yard manure and then proceed to cover the soil with the usual temporary and permanent shade plants, but such a process is within the reach of very few cocoa planters, and where it is, in most cases the treatment would be grudged on the score of unjustifiable expense, and on the happy and most truthful policy that something for nothing is the cheapest way of doing things. Besides that could not correctly be called "natural regeneration," which to appeal to any one as a success must naturally cost little except time, and there is certainly no excuse for grudging time to a barren spot.

To restore the humus as inexpensively as possible is therefore the main object, and provided there is no hurry that ought to be quite possible if we grasp the basic fact in agriculture that so long as any green plant will grow upon no matter how poor a soil in available fertility it is possible with proper treatment in time to make it a comparatively rich soil, because the organic substance of the plant is built from the carbonic acid gas in the atmosphere, and the burial of the body on the spot means the addition of that much humus.

All attempts to supply the barren spot in the ordinary manner without a stimulant would fail for neither the bananas, nor immortels would even pretend to grow, and the labour would be money wasted. The soil must be covered however, and kept covered to arrest the continued leakage from the breaking down of what elements of fertility are left and the hardy natural vegetation now established on the soil is the only thing fit to do it.

Starting, let us say, in the latter half of May as the rainy season approaches, many of the wild trees if present should be barked, the dead branches and wood cut away from the cocoa trees and tar applied to the wounds, and all epiphytic growths and bird-vines removed. The labour cost of these operations need not be more than a dollar a hundred trees. Those which are dead or in a hopeless condition should be resupplied from seed, first by forking holes of two feet diameter and about eighteen inches deep, from which all the earth is drawn out with a hoe and the stones removed, the bottom of the holes being further broken up with the fork as far as possible. A good bundle of grass or any handy plant refuse should then be put in and the earth shovelled back on the top. A similar hole should be dug in the middle of every square for the immortels and planted with good vigorous seed. This of course, is in excess of the ultimate requirements of the field, but the value of the unnecessary ones as a mulch and general aid to fertility will more than compensate for the extra cost. which under ordinary conditions shonld not be more than a dollar per hundred holes. A good plan is to plant three sticks of manioc round, but not encroaching on each hole, just as is done in young cultivation, but the roots should never be dug out of the soil except to be chopped up and returned.

In the case of steeply inclined land—and it is generally on ridges and steep hillsides that barren spots occur—great help will be found in digging between every third or fourth cocoa row what for want of a better name can be called *contour ditches*, that is, perfectly level ditches following the contour of the hillside, about seven inches deep on the low side and nine inches wide at the bottom, the earth being all thrown on the low

side. To do this successfully it is necessary to employ an instrument which will give a correct level, such as an ordinary Dumpy Level, with which it is a very simple matter, for the object of these ditches would be entirely defeated if not dug perfectly level. They are simply catch ditches for the rainfall, and are intended to intercept what they are capable of holding during a heavy flush, induce percolation through the surface soil and prevent some of the loss caused by surface drainage. Every observant planter is familiar with the fact that on steep lands of the sort a heavy shower of rain, particularly in dry season, has so little effect that the soil will be found almost quite dry half an inch below the surface, the water practically running off as from a galvanised iron roof, carrying off much fertilizing material in suspension into the ravines or to lower levels. These contour ditches arrest that, to some extent at any rate, and force percolation where there was practically none before. They may be dug for thirty cents a chain, which at every third row, and with twelve foot spacing of the cocoa trees, works out to approximately a cent a tree. The general slope of the hill may be full of depressions or hollows and blind ravines, but these in no way prevent the work, and where they cause the ditch to meet a cocoa tree or other immovable obstruction, it simply ends and continues on the other side at the same or better still at a slightly altered level, when the beginning of the new piece may be made to overlap the last a little. If the inclination of the land is so steep and its general condition such as to indicate the possibility of landslips, they should be dug shallower and narrower and increased subsequently if safe, or omitted altogether from the scheme.

The field may now be left for nature to work upon until the following May, the only other operation in the meantime being to keep the young supplies regularly weeded whenever necessary. This must be done conscientiously, however, by hand weeding, the weedings always mulched back on the surface round the young plants, which will not cost more than twenty to twenty-five cents a hundred holes. By this time a considerable growth of hardy vegetation will be covering the soil, conspicuous among which will be the ordinary Sage, and equally conspicuous will be the scarcity of Leguminous weeds. This bush should be cutlassed down as close as possible a week or two before the wet season sets in so as to permit the ratoons to spring and catch the liberated plant food when the rain begins, and the bush must be spread as evenly as possible over the denuded surface. This cutlassing will not cost more than fifty to sixty cents per hundred cocoa trees, after which the ditches should be cleaned out at about six cents a chain of one hundred feet, the cocoa trees run over and treated as before, any further deaths being re-supplied, and more of the wild trees barked. The field may again be abandoned for a similar period—remembering always the supplies—but it will be noticed that a much more vigorous growth of bush will result and a heavier mulch be secured in consequence, while a higher percentage of Leguminous weeds will be apparent, besides signs on the better spots of the tenderer ground plants found in thriving cocoa fields.

The mechanical effect of this bush is well worth considering. It is nothing more nor less than a most efficient forking of the soil by the countless roots, most of which are very deep and vigorous, while at each cutlassing those of all the annual and many of the perennial weeds die, which naturally rot leaving innumerable aerating channels, and a considerable deposit of organic matter in the deeper layers of the soil. Equally important is the selective power of these different hardy roots, and their capability of attacking the *insoluble* mineral store in the soil and rendering it available in the organic mulch returned, by which means a better character of herbage is induced.

It will most probably be now necessary to cutlass in the following December or earlier and at least twice a year in future, while at each successive brushing the character of the bush will be seen to improve and get richer in the succulent so-called grasses seen in good cocoa fields. If the mulch is raised the soil appears dark in colour, is moist and cool to the feel, and quite friable.

Another and most important influence may now be observed at work. The mulch seems to be disappearing comparatively rapidly, as if it has been partially raked off and removed, the surface of the soil appears broken into innumerable little lumps, and can be picked up easily in handfulls which are as friable moist and cool as damp sawdust. Moreover, a cutlass can be plunged with ease almost to the hilt where no stones intervene, and it will be found in the same dark coloured friable condition away below the surface. This is an ideal condition of *tilth* which no mechanical process known could quite equal, and has been produced *by the action of earthworms*, which—under the favourable conditions caused by the organic surface mulch and its attendant moisture and cool temperature during the heat of the day and its power of keeping the same equable conditions during the lower temperatures of the night,—have bred in thousands and carried the mulch below. This action is not necessarily equally general all over the field, and probably—were the matter closely investigated—would be found to be more vigorous in some places on account of the worms showing a preference for some particular ingredient in the mulch which grows in abundance there, but it is a most important result to have achieved and is the clearest indication of recovering fertility. This distribution of the organic matter in the soil by earthworms is second only in importance in our *untilled* cocoa soils to the presence of the organic matter itself, and the full magnitude and effect will be appreciated by any planter who will closely observe it working, apart from any more particular knowledge of the action of humus thoroughly mixed and distributed through the soil. One of our best cocoa planters in Trinidad once made the remark "if you can get a good crop of earthworms you will get a good crop of cocoa," which concisely states a full appreciation of this fact.

By this time great general improvement will be apparent in the condition of the old cocoa trees. The branches will appear quite bunchy with leaves, dormant buds will have sprung freely to form new branches, and a number of suckers or renews will probably have established themselves at the bases of the trunks, having the vigorous clean look of young thriving trees, and the mistake should never be made of removing any of them—for a long while at any rate. More than that the number of pods which the old structure will bring to maturity is quite surprising, while the foliage all over has that rich green look which is so unfailing a sign of thriving trees. Bananas may now be supplied as thickly as desired and will be found to grow readily and with vigour, but it is advisable to use them entirely for mulching purposes instead of marketing the produce. They will keep down the rampant growth of bush, which is no longer required, until the permanent cultivation has again assumed complete control of the soil by a uniform covering. The great advantage of having established the cocoa and immortel supplies at the outset as described will be recognised at once in their having had a good start under favourable local conditions without which they would never have lived. They will have attained a very creditable growth at the end of the fourth year, and it will not be very long before a thinning of the unnecessary Immortels will be advisable, from which a rich additional mulch will be obtained. The recovery will of course be more rapid in some places than others, just as progress often is even in new cultivation, and the process must just be continued longer in those

parts until the same result is achieved. This is no doubt due to the remnants of fertility being in different degrees in different spots at the start, most "barren spots" exhibiting places which are not quite so bad here and there.

The experiments of Sachs and Bialablocki—which may be found in almost any text-book on Agricultural Chemistry—have shown that different plants thrive and yield better with different soil temperatures, and a study of the following table of temperatures will show that the cocoa and Immortel are no exceptions so far as this preference is concerned:—

Table of Soil Temperatures in Cocoa Cultivation.

In Degrees Fahrenheit.

			6 a.m.	Noon.	6 p.m.	10 p.m.
	Atmospheric temperature	In the sun ...	...	108	...	...
	Atmospheric temperature	In the shade ...	70	83	77	73
	Soil under thriving cultivation Shaded with Immortels	2″ deep ...	71·6	72·5	73·4	74
	Soil under thriving cultivation Shaded with Immortels	4″ deep	71·6	72·5	72·5	74
	Soil under thriving cultivation Without any top shade	2″ deep ...	72·	73	73	74
	Soil under thriving cultivation Without any top shade	4″ deep ...	72·	73	73	74
Observations made in barren spots.	Surface of soil below fairly thick mulch ...		73·4	82	74·3	
Observations made in barren spots.	Surface of soil below very thick mulch ...		...	78	73·4	
Observations made in barren spots.	1″ below surface of soil underneath fairly thick mulch		71	78	73·5	
Observations made in barren spots.	Bare soil	1″ deep ...	71	88	77	
Observations made in barren spots.	Bare soil	3″ deep ...	...	83	78	
Observations made in barren spots.	Soil where earthworms are working	1″ deep.	72	81	75	
Observations made in barren spots.	Soil where earthworms are working	3″ deep.	73	77	75	

The figures in this Table are condensed from a large number of observations with the view of emphasizing the most salient points—to produce all the readings made with their minor differences being unnecessary for the purposes of this paper. They were all taken during the present dry season at an elevation of about 900 feet above sea level, and on the western side of a valley—that is, with an eastern exposure,—the general slope being about one in five.

It will be seen that the temperature of fertile cocoa soil, with or without immortel shade, is practically constant during the day and night. The temperatures in worn out soils, however, undergo great fluctuation. A difference of 17 degrees is shown on bare soil between 6 a.m. and noon, while there is a rise of only 7 degrees when the soil is protected by a fairly thick mulch, the noon reading of bare soil at one inch depth being 88 while that of the surface of the soil under a fairly thick mulch is 82, 6 degrees less, and 78 an inch below the surface or 10 degrees less. The influence of a surface mulch in keeping the soil cool during the heat of the day is

very marked, and it will be seen that the temperature returns to what may be called the normal for cocoa—about 73 degrees—by 6 p.m., while this condition is maintained through the cooler hours of the night. Where earthworms are working there is a rise of 9 degrees an inch below the surface between 6 a.m. and noon and only 4 degrees at a depth of three inches. The higher temperature at one inch depth at noon is no doubt due to the soil being semi-exposed and worked very loose, for at three inches depth there is only a rise of 4 degrees, while at the same time it will be noticed that the readings are lower than those registered on the surface under a fairly thick mulch.

Without going unnecessarily far into the conclusions which might be deduced from the figures, we may take it that a uniform temperature of about 73 degrees—at this altitude—is a condition which goes along with a soil's fitness—or fertility—for cocoa, and there can be no doubt whatever that this character is supplied to the land by the organic matter only, along with its power of retaining moisture; hence the necessity for building up that important ingredient in worn out soils is obvious (apart from its nutritive value), but the rough natural vegetation is the only natural means by which it may be accomplished because the soil is not fit to grow anything better.

The *unavailable* mineral matters are attacked by these hardy plants and absorbed, the carbon is extracted from the atmosphere, and both are returned to the soil in the form of available fertility by the mulch secured.

It must not be thought, however, that this system will rehabilitate the fertility of any soil *which has been depleted of its store of unavailable minerals*, by such a ruinous system, for instance, as that in vogue in some places of felling land, burning it, and then taking off two or more crops of Indian corn, after which it is allowed to return to bush and again treated in the same manner when there is enough growth to make it worth while. *Nothing but the artificial application of the missing elements of mineral fertility* will suffice on such soils. The organic matter is of minor consequence here, and will follow as a matter of course the soil's regeneration in minerals.

The system is based upon the assumption that our cocoa cultivation supports itself mainly upon the available portion of the soil's fertility, and that its barren condition is frequently due to a deficiency of the same while the soil may still have enough in an unavailable form.

WARBURTON C. JARDINE, F.H.A.S.

Caura,

March 14th, 1909.

121.—Analysis of Cacao soil from Brooklyn Estate.

(*Read at a meeting of the Board, 18th June, 1909.*)

GOVERNMENT LABORATORY,

7th June, 1909.

SOIL "BROOKLYN ESTATE," SANGRE GRANDE.

The sample contains:—

Water	3·68
Volatile matter and combined water	7·46
Mineral matter...	88·86
	100·00

COMPOSITION OF SAMPLE DRIED AT 100° C.

* Volatile matter and combined water ..	7·750
Soluble silica	·384
Oxides of iron and Alumina	10·787
Lime	·057
Magnesia	·192
Potassium oxide	·287
Sodium oxide	·155
Phosphoric anhydride	·096
Sulphuric anhydride	·124
Chlorine	·002
Insoluble silica and Silicates	80·148
	100·000

* Containing :—

Total Nitrogen	·158 %

AVAILABLE PLANT FOOD.

Potassium Oxide	·0080 %
Phosphoric anhydride	·0040 ,,
Nitrogen as Nitrates	·0016 ,,

JOSEPH DE VERTEUIL,
Asst. Govt. Analyst.

X.—MANURES.

122.—Fertilizers and Feeding Stuffs Ordinance. (No. 1 of 1909.)

THIS Ordinance came into force on the 4th January, 1909.

The Regulations under Section 9 were published in the *Royal Gazette* on the 6th May, 1909.

The following are the principal sections :—

Section 3.—The Ordinance applies to wholesale as well as retail sales.

Section 4.—Every seller of Fertilizers or Feeding Stuffs must be licensed and must be a resident in the Colony. Licenses are obtainable from the Inspector-General of Constabulary and are free of charge.

Section 6.—The warranties must contain the following particulars in the case of

(a.) *Manures.*

Nitrogen,	percentage of.
Phosphates soluble,	do.
,, insoluble,	do.
Potash,	do.

(b.) *Feeding Stuffs* (artificially prepared).

Oil,	percentage of.
Albuminoids,	do.

An invoice or advertisement has the effect of a warranty.

Section 8.—Every purchaser may have a sample analysed at the Government Laboratory on payment of such fee as may be fixed by the Governor, and he may have the sample taken by an official sampler. This section gives detailed instructions as to the procedure in taking and analysing samples.

* The analyses of this soil shows that it is deficient in lime and phosphoric acid and that the ratio of magnesia to lime is too high.

Section 9.—Gives power to the Governor to make regulations.

Section 10.—Deals with offences. It is an offence :—

(1.) to delay delivery of an invoice beyond 24 hours.
(2.) to permit any invoice to be false in any material particular.
(3.) to sell for use as a food any ingredient deleterious cattle or poultry.

The penalty for a first offence is not to exceed £20 or, in default, imprisonment with or without hard labour not exceeding three months for a subsequent offence the penalty is not to exceed £50 or, in default, imprisonment not to exceed six months.

These penalties are in addition to any civil liabilities that may be incurred.

Section 11.—Deals with tampering,

(1.) with the sample,
(2.) „ invoice,

and the penalties are a fine not exceeding £20 or, in default, six months imprisonment with or without hard labour, or imprisonment not exceeding six months without the option of a fine.

Section 12.—Deals with refusal to allow an official sampler to take a sample, or refusal to give an official sampler an invoice or a copy thereof, under a penalty not exceeding £10.

Section 13.—For selling without a license the penalty is not to exceed £20 or, in default, imprisonment not exceeding one month.

The Regulations published in the *Royal Gazette* give very full details as to the prescribed methods of analysis.

The fees for analysis were published in the *Royal Gazette*, 3rd June, 1909, and are as follows :—

MANURES.

Complete analysis of guano, sheep or other manure, ammonia salts, soda salts, potash salts, gypsum, dried blood, superphosphates, bones, fish manures, bone black, bone ash, mineral phosphates, slag phosphates, and precipitated phosphates ...	$ 5 00
Complete analysis of mixed artificial manure, with an estimate of value	10 00

FEEDING STUFFS.

Determination of one constituent	$ 2 00
Determination of each additional constituent ...	1 00
Determination of oil and albuminoids in coconut cake or meal	1 00
Commercial analysis of any other oil-cake or other substance used for feeding purposes	5 00

123.—Analysis of Wild Pines.

Wild Pines as a Mulch.

(*Read at a meeting of the Board, 18th June, 1909.*)

Information was received from one of our Cacao planters that he had obtained remarkably good results from the use of wild pines as a mulch. In order to ascertain if they possessed any manurial value an analysis was made with the following results :—

GOVERNMENT LABORATORY,
2nd June, 1909.

Sample of Wild Pine "Aechmea nudicaulis" received from the Board of Agriculture.

The Sample contained :—

Water	76·25
Organic matter	22·70
Ash	1·05
	100·00

The organic matter contained 0·42 per cent. of Nitrogen. The sample was cut up in pieces from ¼ to ½ inch square and spread out as a mulch ½ inch thick. After 10 days it still retained 13·06 per cent. of water.

Percentage Composition of Ash.

Insoluble silica	3·34
Soluble silica	4·48
Oxide of iron	·31
Lime	12·60
Magnesia	5·55
Potassium oxide	26·66
Sodium oxide	11·46
Phosphoric anhydride	4·76
Sulphuric anhydride	2·02
Chlorine	8·26
Carbon dioxide	20·56
	100·00

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

XI.—PLANT DISEASES, &c.

124.—Report on Diseased Rose Twigs.

SPECIMENS of diseased Rose twigs recently received have been reported upon by the Mycologist to be covered with the fruiting bodies of a fungus belonging to the genus *Stilbella*, and that when inoculated in perfectly healthy plants the disease spread rapidly killing the tissues.

REMEDIAL MEASURES.—Cut back diseased twigs to at least two or three inches beyond the discoloured area, then spray with Bordeaux mixture or perhaps better Lime-Sulphur Solution 1—30, repeated in eight or ten days.

One pint Commercial Lime Sulphur mixture (38° Beaumé) is sufficient for at least 20 plants.

XII.—ENTOMOLOGICAL.

125.—Locusts at Cedros.

THE Warden at Cedros reported that Locusts had appeared at Icacos and forwarded specimens. The place was inspected by the Director, and the swarms were seen to be small and scattered. Further specimens were secured for the Board's Entomologist to rear. These are still under observation.

The Warden was requested to report if the locusts became more numerous; but no further report has been received.

These locusts appear at fairly regular yearly intervals but no serious damage has hitherto been reported. The Locust Ordinance requires the planter to bear the cost of destroying them.

XIII.—LIVE STOCK AND POULTRY.

126.—Difficulties in maintaining Pure Bred Stock.

(*Transvaal Department of Agriculture*).

THE following article shows that the difficulties experienced here in connection with the introduction of pure bred stock are similar in other colonies:—

" I have serious misgivings about the ultimate success of those breeders who import pure bred cattle from Europe and keep to that particular breed. Those highly bred animals may answer very well in the particular climate of their home, but their very perfection has reduced the stamina; they are probably more liable to contagious disease, less hardy and resistant.

It is somewhat like the highly improved garden flowers, which can be kept up to the mark only by the greatest care and attention, and have lost that resistance which the wild flowers they descended from show to adverse circumstances.

An illustration of my meaning unfortunately happened quite recently in Cape Colony, where an outbreak of tuberculosis was discovered among pure Frieslands, Colonial bred. Pure breeds from Europe, whatever race they belong to, must live here in an entirely different climate and though quite free from tuberculosis on entering South Africa, they may contract it here, partly on account of the different climate, the change of food, and less careful treatment than they are accustomed to.

A very few farmers may be successful in breeding pure stock in South Africa by giving all their care and attention and by making their cattle their main business. Even then disasters are possible, as the case in Cape Colony showed. But if the ordinary Transvaal farmer, who is practically unaccustomed to giving dairy cattle their proper treatment, goes in for pure breds, it is to be feared that the herd will suffer and deteriorate.

It seems to me a better policy to cross the pure breds with some local animal accustomed to climate and soil and not requiring so much attention. The crosses should show better milking qualities than the local cattle and more stamina than the pure breds.

Gradually the strain can be improved by intermixing more pure blood and the same time that the strain improves, the farmer should learn the proper treatment of the dairy cattle.

Under inadequate treatment any herd will deteriorate, therefore it is indispensable that the farmer should learn how to deal with a dairy cow if he aspires to possessing a good milking strain.

In crossing, a definite plan should be followed and, if once a certain pure breed has been selected for improvement, then this breed should be adhered to. I have seen in this country cattle that could not be called "crosses," but deserved the name "mongrels." Crossing has been carried on such a haphazard style that for many animals it is not possible to say which strains are intermingled."

127.—Chicken Pox or Sore Head—(Epithelioma contagiosum).

(*Agricultural Journal*, Cape of Good Hope, March and April.)

TREATMENT:—On the occurrence of an outbreak of chicken-pox, all diseased birds should be isolated away from the healthy ones. The fowl houses should be thoroughly cleansed and disinfected, Jeyes' Fluid, Izal, Carbolic Acid, or other disinfectant being used for this purpose.

In the early stages of the disease the lesions should receive frequent applications of tincture of iodine, or solution of cyllin (1 or 2 per cent.), or carbolic acid (4 to 5 per cent.) When the mouth and throat are affected it will be advisable to apply the cyllin solution directly to the affected mucous membrane; for this purpose one authority recommends the following formula:—

Creolin or carbolic acid	5 parts.
Glycerine	100 „
Water	100 „

It is of course very necessary that the bodies of any birds which succumb to the malady should be burned, or deeply buried.

The following treatment has also been recommended in the Journal for April 1909:—

1 teaspoonful flower of sulphur;
1 „ Little's liquid dip;
1 „ turpentine;
1 tablespoonful linseed or salad oil;

Mix well together and apply to all the warts so as to completely cover them. One application of this mixture is generally sufficient, but in some cases a second application may be necessary. A stiff feather is a good medium with which to apply the remedy.

XIV.—AGRICULTURAL INSTRUCTION.

128.—Education in Practical Agriculture.

Report by the Director of Agriculture.

THE wants of the Colony in this branch of Education appear at present to lie in three directions, viz.:—

1. Reading Courses for those who are already engaged in Agriculture.
2. Training Courses to qualify as Managers of small estates.
3. Training Courses for skilled labourers.

For the first, the Government has made provision in the Estimates and the details of the scheme are in an advanced stage of preparation.

For the second, the Board may reasonably be expected to provide the necessary financial assistance. The Department of Agriculture at the Laboratory and the St. Clair Station can give the necessary training in Chemical and Botanical knowledge, and some experience in cacao at *River* Estate, and in the management of Stock at the Government Farm. These Courses include the initial requirements of local agriculture and prepare the way for further studies at other centres. A young man, spend-

ing 3 months at St. Clair, 3 months at the Laboratory, from 6 to 12 months at *River* Estate, and from 3 to 6 months at the Government Farm should at the end of that time be of much more utility and value than the present applicants for agricultural employment who have to be trained on estates very often at the expense of their employers or patrons. General training is, in the beginning more advantageous than specialised training. A course of lectures at the Victoria Institute similar to the last one should form part of this scheme.

It is advisable that some remuneration should be given by the Board for actual services rendered by students in this branch. The amount may be small, but it can be made to act as a stimulus to earnest work by making such remuneration conditional on satisfactory results.

The Board should also grant a Diploma in Agriculture to those who have satisfied its requirements, and would naturally endeavour to find suitable employment for them afterwards.

The third section might be connected with the Board of Industrial Training and apprenticed under the usual conditions. Or the Board might start its own system of apprentices. This section would endeavour to supply skilled workmen who would probably afterwards become useful gangers or drivers on Cacao and other estates.

A Committee of the Board might be appointed to deal with the proposed scheme.

129.—Education—Outline of Scheme.

The following is an outline of the scheme submitted to the Board by the Director :—

I.—Labour Apprentices.

Certificates after one or two years' continuous employment at the Experiment Station, or after a shorter period, if in the opinion of the Superintendent the lad is fully qualified.

Age above 13.

To be employed as an ordinary day labourer and paid according to the worth of his labour.

Certificated apprentices may receive six months training in cacao at River Estate and be paid at the usual rate; and a further three months at the Government Farm under similar conditions. These additional courses will be endorsed on the Certificate.

There need be no form of agreement binding on either party. At the end of the periods mentioned a Certificate of training in each branch will be issued.

Labour Apprentices' Training at Government Farm.

1. Cutlassing, mowing, and cleaning pastures.
2. The care and management of pigs and poultry.
3. The duties of a herdsman in attendance on stock.
4. The grooming and feeding of horses.
5. Milking and attendance on cows. (Milking optional.)

II.—Overseer Apprenticeships.

An agreement to serve a certain period will be required in this case.

The course of training would be of the following nature :—

1.	Routine work to include all kinds of hand labour ...	2 months.
2.	Grafting and other skilled gardening operations ...	4 ,,
3.	Cacao training at River Estate	6 ,,
4.	Stock Farm training at Valsayn	3 ,,
5.	Chemical training at Laboratory	3 ,,

Time for reading would be allowed at certain hours. A course of about 30 lectures will be arranged for according to the syllabus attached.

A small monthly allowance will be paid to those whose work is satisfactory.

Overseers' Training at Government Farm.

1. Supervision of labourers.
2. Time keeping and appraisement of labour.
3. Measurement of field work.
4. Supervision and care of stock generally.
5. Supervision of stores and distribution of same.
6. Cultivation and reaping of bananas.

III.—Planter's Courses.

Courses of reading and examination for those already engaged in agriculture have been prepared and will be published shortly.

IV.—Prizes for Good Cultivation.

One of the best ways of encouraging good labour and stimulating practical education is to offer prizes which may be competed for annually by small proprietors.

This can be done advantageously in connection with the work of the present Agricultural Inspectors. The prizes should be awarded to those cultivators who most successfully carry out the advice and instruction of the Inspectors. At first this scheme would apply chiefly to cacao cultivation.

Proposed syllabus in connection with the scheme for Agricultural Education.

Division of Science.	*Number and Subjects of Lectures.*
1. Physics and Chemistry	1. 2. Study of chief elements connected with plant life. 3. Heat and Climate. 4. Hydrostatics and Hydraulics. 5. Soils. 6. Manures.
2. Agricultural Surveying ...	1. Measuring ground and placing boundaries. 2. Drainage and irrigation. 3. Road-making and repairing.
3. Botany	1. How plants are constructed. 2. How plants live. 3. How plants are classed & named.
4. Horticulture ...	1. 2. Propagation and rearing of young plants. 3. Formation and maintenance of a garden.
5. General Agriculture ...	1. Draining and Tillage. 2. Manuring and Mulching. 3. Planting and Shading. 4. Cultivation of an established plantation. 5. Pruning and Training. 6. Diseases of Plants.

6. Agricultural Entomology	...	One lecture.
7. Animal Husbandry...	...	1. Management of Live Stock and Dairying. 2. Veterinary Anatomy and Hygiene.
8. Agricultural Law and Banking...		One lecture.
9. Special Division ...	...	1. Cacao. 2. Fruit. 3. Rubber. 4. Coco-nuts. 5. Sugar-cane. 6. Minor Products. 7. Management of Labour.

XV.—MISCELLANEOUS.

130.—Increase of Mongoose.

THE Manager, Caroni Estate, reports that 240 Mongoose have been trapped there within a period of about six weeks. This clearly points to the fact that this animal is becoming a serious danger, and to the necessity of taking more vigorous action to diminish its numbers. Caroni is not the only district where the mongoose is increasing.

131.—Increase of Frog-hoppers.

FROG-HOPPERS are stated to be increasing in numbers (June 15).

132.—New Markets for Produce.

IN every agricultural country, the question of finding new markets for produce has always been an important one. Formerly this was left entirely to the resources of individuals engaged in commerce, and this is to a considerable extent the practice at the present time. But in recent years the Governments of every progressive country have taken a prominent share in finding new outlets for trade.

With Consuls and Consular Agencies in every part of the globe it was possible for the Governments to do so without any great additional outlay. In the Board of Trade Journal (British) each weekly number contains articles on "Openings for British Trade," "Confidential Information" and "Commercial Intelligence Branch." The first deals with enquiries and tenders for goods, machinery, construction materials, &c.; the second with confidential information, not for publication, which is supplied to any British firms whose names are registered at their request; and the third is intended to be a centre at which information on all subjects of commercial interest is collected and classified in a form convenient for reference, and includes a sample room. As an instance of the utility of the latter the following examples are chosen from among the latest additions:—

Phosphate from Natal.
Candelilla plant and wax from Mexico.
Court Plaster (German) and Paper (Dutch), both bearing British Royal Arms, sold in Spain.
Standard fair average quality Western Australian wheat of 1908–9.
Machetes sold in Panama.
Rice and Cotton from Bolivia.
Bean Oil from Japan.
Filasse produced from Ramie fibre.

I have been unable to search many of the back numbers but I hope they include the following:—

Paper from Megass	from	Trinidad.
Manjak	,,	,,
Petroleum	,,	,,
Asphalt	,,	,,
Cotton	,,	Tobago.
Rubber	,,	,,

Trinidad Asphalt (world-famed though it is) is not sufficiently well known in England if one may judge so from the fact that recently I have been twice asked to supply for analytical purposes specimens of the different kinds of asphalt found in this Colony, and from the conflicting evidence recently given in a trial at London in connection with Trinidad Asphalt.

It is necessary in the interests of trade that every Colony should make some attempt, even in a small way, to find new openings for trade. This Colony has done, and is doing, something in the way of sending exhibits to different centres; and in recent years regularly to Canada. The only effort that has been distinctly successful was that made at the Chicago Exhibition in 1893. On that occasion the planters gave freely of their cacao, and a distinct impression was made on the American consumers. The annual averages of our export of cacao to America were in the period 1891–5 only 5,200,000 lbs., in 1907–8 the export amounted to 16,700,000.

Speaking generally there is no direct evidence of new openings for trade directly traceable to exhibitions in which we feebly attempt to partake. There is certainly more prospect of success in following the lines adopted by the British Board of Trade.

Having once secured a market it is of very great importance to retain it. In this connection, produce of good and uniform quality counts at the present time for a good deal, and will probably continue to do so in the future. The governments of some countries have taken up the question of standardising with material benefit to agriculturists. A Government guarantee is of considerable assistance to buyers. Nothing of that kind has yet been attempted here; but some Cacao Planters have formed an Association for a similar purpose and it is reported with success.

There are many other factors on which retention of markets depends, and those interested should guard them jealously.

P. CARMODY.

133.—Illustration of Castnia licus Moth.

The illustration of the *Castnia licus* moth issued with the last number of the *Bulletin* was lithographed at the Government Printing Office.

With this issue are included lithographs prepared at the Government Printing Office of the Guayule Rubber plants, and of nodules occurring on Immortel roots.

134.—Bulletin last issue—Letters received.

THE following extracts are taken from letters recently received:—

I have noticed in the present *Bulletin* (January and April 1909) an article on plant diseases arranged in tabulated form by Mr. A. E. Collens. If there is any still on hand kindly let me have one; and any other paper which treats of plant diseases and their remedial treatment.

(Separate copies of this can be obtained on application.)

* * * * * *

Being interested in Agriculture and having seen some valuable information sent my brother by your Department, I am deeply impressed with their value. As I intend going to plant cacao at an early date at Cunupia, and such information as obtained from your Department would be priceless value to me.

* * * * * *

I find it very instructive indeed. By the instructions offered therein, coupled with my little practical knowledge of cocoa cultivation, I feel confident that I shall be able to combat the diseases which are very much prevalent in cocoa here, viz.;—Canker, Root-rot and Blight.

* * * * * *

It is of great value, especially as a good deal of information is required among the small cultivators in the proper manner of tilling the soil and husbanding their plantations.

* * * * * *

XVI.—MONTHLY REPORTS, &c.

135.—Monthly Reports—Agricultural Inspectors.

(Read at a meeting of the Board on the 23rd April, 1909.)

I have the honour to report that I assumed the duties of Agricultural Inspector on the 1st instant.

From that date to the 9th instant my time was employed, at the offices of the Department of Agriculture, in two visits to St. Clair Experiment Station, and at the Warden's office obtaining information of the properties in the district I proposed first to inspect. I commenced inspections on Saturday the 10th instant at Laventille, proceeding along the Eastern Main Road to San Juan and the Santa Cruz Valley.

I. Estates Visited.

No inspections were made of large estates, but 109 small holdings varying from a half lot to seven quarrees were entered and inspected, in addition many were only observed from the road, the owners being absent.

Cultivation.—In 102, chiefly coconuts mixed with various fruit trees, and occasionally a few cacao trees. The remaining 7 varying from one to seven quarrees planted in cacao.

State of Cultivation.—With two exceptions, (Messrs. T. I. M. and A. B.,) there is practically no attempt at cultivating coconuts. Cacao shews better cultivation, but only in one instance has any attempt been made to take sanitary care of the trees and to treat them for canker.

Diseases.—Bud rot and stem diseases of the coconut, canker and root diseases of cacao, were observed.

(*a.*) *Nature.*—Bud rot of coconut very prevalent, increasing in virulence going East culminating on the M. estate, a rough counting of the dead palms still standing, on the places visited, amounts to 584 besides 128 affected palms.

Three instances only of stem disease were observed, the first, an apparently healthy palm bearing well, but bleeding profusely from about 15 feet up down to the roots. The second, dead, with the crown dropped off and shewing slight signs of having bled. The third, sickly, bleeding from nearly halfway up the stem, and shewing numerous perforations.

Canker in bleeding stage observed on cacao, a symptom resembling the dry stage after bleeding, observed on a bread-fruit tree growing amongst coconuts and in proximity to the first instance of stem disease reported above.

Root disease is suspected as the cause of death of three trees observed in a cacao field at La Canoa, specimens of the roots were obtained for examination, specimens of the stem disease and the suspected canker on bread-fruit were also obtained for investigation.

(*b*.) *Treatment practised.*—With regard to the disease of coconuts, in only two instances had the felling and burning of dead and affected trees been systematically practised, but has now been discontinued as no check to the progress of the disease was observed, due no doubt to want of co-operation.

In a third instance a rather startling, but emphatic claim of having cured six affected trees, by the application of fire to the exterior and salt or lime water to the interior of the crown, was made.

I am of opinion however that the stunted appearance of these palms and others in the same field, does not indicate the disease under consideration, but points to plant starvation, due probably to excess of water. I have mentioned this treatment as it is probably within your recollection, that a similar treatment met with some approval in Jamaica some years ago.

(*c*.) *Treatment recommended.*—In all cases improved cultural methods, drainage, and strict attention to plant sanitation.

Disease of the coconut, preventative measures, the felling and burning of all dead or affected palms, leaves, &c.

Canker of cacao tree, excision of diseased area, antiseptic dressing of tar, or manjak and rosin oil, to all wounds, burning of all diseased material, liming and burying of cacao shells.

Root disease of cacao tree, lay bare the roots, remove diseased parts and burn, apply about 8 lbs. lime in holes thus formed, watch closely, the surrounding trees for possible infection.

II. General.

Diseases as reported above. Bud rot of coconut at Laventille and Santa Cruz, a few palmistes were observed dead apparently from this disease.

Stem disease at Laventille.

Canker of cacao trees at Laventille and Santa Cruz.

Root disease of cacao trees at San Juan, La Canoa.

Bird vine (Vagc) was observed to be fairly abundant at Laventille, on fruit trees, principally oranges and mangos.

A specimen of the bearded weevil, (*Rhina barbirostris*), was obtained on the crown of a palm recently dead and felled for the purpose of examination, some grubs were also found in the putrid crowns of some of these palms.

In conclusion, I must draw attention to the serious difficulty in the matter of drainage, under which the people of Laventille labour, owing to the large canal known as the "Cocal" no longer being kept open.

L. A. Brunton,
Agricultural Inspector.

21st April, 1909.

136.—

(*Read at a meeting of the Board on the 21st May, 1909.*)

I have the honour to report that 104 cacao-plantations varying from three to forty acres in extent were inspected during the month, 42 in the hills and valleys of Belmont and Laventille, and 62 in the Santa Cruz valleys.

At Belmont and Laventille, where but few owners live on their properties, cultivation is very poor, a large majority being practically abandoned; at Santa Cruz the owners being more dependent on their properties, more attention is paid to the ordinary methods of cultivation, but only in a few instances has any attempt been made to introduce sanitary measures, which however, in all but one instance, have been very indifferently performed.

The diseases principally met with have been canker of stems and branches and root disease.

The former has been universally met with, but is more severe at Belmont and Laventille than at Santa Cruz where it is confined chiefly to the stems. A specimen of what seemed to be canker affecting an Avocado Pear tree was obtained at Santa Cruz and brought in for examination. Dieback also appeared to be associated with canker on a plantation at Belmont.

Root disease has been found only at Santa Cruz, particularly at La Canoa, Gasparillo and Grande Curucaye, where it has been doing considerable damage, and is undoubtedly being communicated from one estate to another; on a property in the latter valley it has evidently been present for some years, and has killed nearly half an acre of cacao and is still spreading.

Brown rot has been occasionally met with in both districts. In two instances where coconuts were included in the cultivation many were observed dead and some dying, evidently from bud rot, whilst one was seen with the stem bleeding.

Of insect pests, evidence of the work of Borer beetles, and Twig girdlers, has been encountered, but none of the grubs or insects responsible for the damage were secured. Whilst however, searching for a cacao worm, a cricket, which appeared to be responsible for the tunnel, was discovered. Podhoppers with their accompanying ants appeared sufficiently on an estate at La Canoa to warrant measures being adopted to suppress them.

Complaints of the damage done by rats in the Santa Cruz hills have been numerous.

The inability of the trees to hold their fruit after setting was very noticeable in certain parts, particularly at Laventille, and advice as to the best methods to be adopted to prevent this loss was frequently asked for and given.

It is pleasing to be able to report that in every instance a courteous and attentive hearing has been given to the Inspector, and only once have his credentials been demanded.

On the other hand inevitable disappointment has been met with, when advice as to the treatment and prevention of some disease has only been partially followed, thus tending to discredit the whole.

L. A. Brunton,
Agricultural Inspector.

15th May, 1909.

137.—

(Read at a meeting of the Board on the 18th June, 1909.)

I have the honour to report as follows on the inspection of 56 properties made during the month.

With regard to the diseases observed in the Santa Cruz district, where 30 properties were inspected, I have only to repeat the information contained in my last report, emphasizing, however, the damage caused by root disease.

From 1st June, I made Arima my temporary head-quarters whilst making inspections in the surrounding district. On the majority of properties visited in the heights of Aripo and Guanapo, the most noticeable feature observed, was the injury to young cacao leaves caused by leaf borers or caterpillars. Careful search in the L'Orange district, where the damage was most extensive, only revealed the presence of a few minute grubs feeding on the young leaves; it is hoped that by continued observation at different hours the cause of the injury will be discovered.

Canker was found on all the properties visited but only to a limited extent, especially in districts composed chiefly of young plantations; planters were therefore strongly recommended to use special precautions to prevent the spread of this disease.

Root disease occurred on two or three estates where neglected cultivation created all the conditions favourable to its development.

L. A. BRUNTON.
11th June, 1909. Agricultural Inspector.

138.—
(*Read at a meeting of the Board on the 23rd April, 1909.*)

I beg to submit the following report of my inspection of properties and holdings of peasant proprietors in the St. Ann's District to the 15th instant. I must also add that I commenced my visits of inspection on the 10th instant, as I was in office up to that date.

In all I inspected thirty-one properties. I started from the top of the mountains from the Santa Cruz boundary, working downward through Cascade Valley, Ariapita and Hololo.

Speaking generally these properties are far from being properly cultivated. From what I gathered in the course of conversation, these proprietors depend more on their "gardens" (provision growing) for a means of livelihood; their cocoa trees taking second place. In several places squirrels had destroyed every pod of cocoa that I saw. On one tree I counted forty-one pods that had been destroyed in this way. They had dried on the tree but I could see that they had been eaten. I noticed an abundance of bird vine on the cocoa trees, and most of the shade trees were entirely covered by this vine. The shade used is generally mixed fruit and wild trees. I noticed very few immortelles, and only one that was diseased. I think the neglect already alluded to is not due to carelessness. The soil is extremely poor for the cultivation of cocoa, being a stiff deep red clay with an abundance of rugged, white and reddish stone, known locally as "warratal." But provisions and especially pine apples grow well.

One proprietor assured me that he possessed 4,000 cocoa trees, and the annual yield was 9 bags. This may appear extraordinary, but the average obtained from other proprietors—of course I take their word for it—is very little higher; and from my own observations I scarcely think it would go over 4 bags per 1,000 trees.

Mr. S.................. is about the only real exception as far as I have observed. He possesses a good little property of about 9,000 trees, giving him 90 bags annually. The property is well situated, a high cliff to the northeast forming a perfect wind break. Mr. S. .... has tried white lime and forking with some success. He has also tried forking in ashes around a few trees which had given him better results than those treated with lime.

I noticed canker, black pod and brown pod on nearly all the properties I visited. There are several very bad cases of canker. The cocoa beetle* is also doing considerable damage. I demonstrated practically to most of the people, and also explained the present improved methods of looking for and treating canker and other diseases. Also the harm done by insect pests, and the benefits that would naturally accrue if they would go in more for higher cultivation. I did not go too far here, as I thought it better to take them slowly at first.

On the whole I have been favourably impressed. The people received me kindly, and with one exception gave me all the information I wanted readily. They were evidently interested in all I told them, and many expressed a wish that I would be up their way soon again. I promised to return at an early date, and informed them that my services were at their disposal at any time. One or two proprietors asked me how much I intended to charge. I informed them quickly that my services were free, which appeared to please them.

I also paid a visit to Maraval and Diego Martin, more to gain some knowledge of these districts before I begin work there.

Before closing, I must say that without exception, the proprietors or their representatives whom I met had not known or heard of canker before. All diseases to them come under one heading, and is put down to "the worm."

D. C. PLUMMER,
Agricultural Inspector.

19th April, 1909.

139.—

(Read at a meeting of the Board on 21st May, 1909.)

I visited seventy-four properties at St. Ann's, Maraval and Diego Martin, the majority at the latter place. At St. Ann's I found much the same conditions as in my last report.

I visited Saut d'Eau, La Point and Mal d'Estomac (Maraval), to investigate into the complaint of twenty-four petitioners, *re* unusual loss due to destruction of cacao pods, young, full and ripe, by rats.

I had not the time, (I spent two days there), to visit all the properties, but I saw enough to be able to report that their complaint is sincere and in no way exaggerated. The amount of cacao lost in this way is certainly unusual. I took this opportunity to point out canker, (a few trees had been attacked on several of these properties), to the proprietors and conversed with them, advising careful and thorough work.

Here I noticed an unusual amount of tiny cacao beetles under the young leaves. This beetle is known as the leaf borer, and punctures the young leaves which curl up and dry at the point and edges.

At Diego Martin I found that canker had attacked one or more cacao trees, with the exception of two young cultivations which I found healthy, on all other properties I visited.

At Four Roads, Petit Valley and Carenage it had been the cause of the death of a good many cacao trees, and I noticed several mango trees that had died, and are apparently dying from the same cause. This was brought forcibly to my notice, because in each case that I discovered a mango tree diseased in this way, *i.e.*, rusty spots on bark, discolouration of bark and wood, the wood being spongy, I noticed that the cacao trees in the vicinity of these mango trees were severely attacked by canker.

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* *Steirastoma depressum.*

About one to two miles from Carenage, on the Chaguaramas road, I was struck by the unusual amount of dead and dying cacao trees, especially young trees. Here this rather wholesale destruction was put down to the heat of the sun or "the worm." But it is due to canker. I had for the first time to recommend the destruction of a good many trees which were too far gone for treatment, and also the removal of and burning of dead and dying trees. To make this task easier and give it a double object, I recommend the use of dry cacao wood as fuel which I have often used in my own kitchen, and found it very good. I think the idea will catch on, and I am glad to report that a few trees have been cut down in my presence.

I paid much attention to trees attacked by canker, and in almost every instance it could be traced to careless work. At Petit Valley, on several properties belonging to East Indians, the part of the trees attacked is low down, and without exception I found that the trees had received wounds, evidently when these places had been cutlassed.

I do not think that all my recommendations will be carried out at once. A few of the proprietors appear to think that cacao trees are there to pick cacao from, and there it ends, for them. One proprietor believed in Fate, and thought that a cacao tree had a day to die, and would die on that day, doctor or no doctor. But I am pleased to be able to report that the majority, those who really live by and take an interest in their cultivations, not only will, but have already begun to follow my recommendations to a certain extent at least.

I noticed very few trees that were dead or dying from root disease and less even affected by Dieback, though in one or two cases where I noticed the latter, the trees were also attacked by canker.

On the whole these properties are in a fair condition, but little attention has been paid to drainage, and with few exceptions work has been carried out on the old principle of "get as much as you can and give back as little as possible." And I am sorry to say that the little has been given back in a careless manner, and this is the only reason, in my opinion, why canker is so prevalent in this district.

On the other hand there are a few who are following the example set by the larger proprietors. They use tar, they say, because they have seen Mr. So-and-So using it. But most of these are applying the tar *over* the cankered area.

One proprietor had been mixing lime with tar, but of course this treatment could have no desirable results as the mixture was applied over the part affected by canker. I make these remarks to show that a few of the people have ideas, and are willing to work their estates on sanitary principles.

By special request I visited one large estate, and I actually visited many more properties, but the proprietors being absent I could obtain no information.

(Sgd.) D. C. Plummer,
Agricultural Inspector.

May, 1909.

140.—

(Read at a meeting of the Board on 18th June, 1909.)

I beg to submit the following report: For this period I actually inspected 38 properties, 25 at Diego Martin, St. Ann's and Maraval, and 13 between Caparo West and Tabaquite. By special appointment I visited one large property at Petit Valley, Diego Martin, and by special request one at Brasso, Montserrat.

As in my last report, I found canker rather serious and extensive at Diego Martin; and combined with careless work, the grubs of cacao beetles (*Xyleborus perforans* and *Tomicus* sp.) are responsible for much of this disease.

The few properties I inspected at St. Ann's and Maraval are affected by canker, but not to any great extent.

I have not been sufficiently long at Caparo to report generally and authoritatively on the extent of diseases. On several small properties, owned by intelligent and hard working men, all bounding together, canker and dieback have taken a strong hold. It was also reported to me by these gentlemen, that at least 1-5th of their crops are lost, the pods turning brown just before they became full. This I could not observe as the cacao trees are now bare of fruit. The properties are thoroughly drained, and are in very fair condition. I recommended the usual treatment for canker and dieback, care not to wound the cacao trees, a light application of lime over certain parts of the land when the weather is more favourable, and a thorough application of lime (fresh) on the broken heaps thus:—the broken heaps to be spread out thinly and thoroughly limed, then one man to shovel the shells slowly from the outer edges to the centre, while another throws on the lime until the heap is formed. I have not recommended, but I think that after a certain period, (I would be glad for this information) heaps should be turned and re-limed in the same way.

On one property at Brasso root disease in immortels (*Anauco*) is very severe. Over certain spots all immortels had died, but the cacao trees were not in any way affected, and the proprietor had sustained no loss from short crops. Wind does not in any way affect these spots, and no manuring or forking has been undertaken. The cacao trees appear to be in perfect health, but the leaves are of a lighter green, and are a trifle smaller than those under shade. I recommend the proprietor to send in specimens of the diseased roots to the Department.

D. C. Plummer.
Agricultural Inspector

Caparo,
June, 1909.

141.—Reports of Entomologist.

(Read at a meeting of the Board on the 26th February, 1909.

I beg to submit the following:—I assumed the duties of Entomologist on the 16th January. Some days were spent in Office in connection with the preliminary work of making out requisitions for apparatus, forms, etc. Pending the receipt of the former more field than laboratory work has been done as follows:—

Coconut disease at Laventille.—Four days were spent at Laventille collecting insects that may have some connection with the diseases now prevalent in this district. The life histories of the insects collected are being worked out. A preliminary report was submitted to the Board on the 29th ultimo.

Castnia licus or Cane-Sucker.—Two days were spent on Caroni Estate collecting data and material from the cane fields for working out the life history of this moth. Material was also collected from Caledonia Road, Laventille, from young coconut palms. Some notes on this insect were prepared for the *Bulletin.*

Frog-hoppers.—In connection with these pests material and data were collected from Caroni Estate, Laventille, Williamsville, and the vicinity of Port-of-Spain with the object of finding out the prevalence of the insect at this time of the year, and discovering any phases in its biology that would facilitate its destruction. These investigations are still proceeding. A short paper on Frog-hoppers was prepared for the Sugar Cane Blight Committee of the Agricultural Society.

Information on Insect Pests.—Nine enquiries were answered, the most important of which was relative to a parasitical fly on Cotton worms* forwarded by Mr. T. Thornton, of Tobago.

F. W. URICH,
Entomologist.

26th February, 1909.

142.—
(*Read at a meeting of the Board on 26th March, 1909.*)

I beg to submit the following:—

Coconut Insects.—Two visits were paid to the Laventille District, but there is nothing new to report; owing to the dry weather insects are becoming rarer. From material collected a fly was bred from a pupa of the "Bearded Weevil" (*Rhina barbirostris*), but it is doubtful whether it is of any economic importance. The life histories of some of the insects begun last month have not yet been completed. A circular asking for information on the "Bearded Weevil" and coconut insects in general was issued in the course of the month, but so far no replies have been received.

Castnia licus or Cane-Sucker.—A special look-out was kept for eggs of this moth on recently cut cane stumps, but none were found. There were no eggs to be found on growing canes. It would appear as if the moths are not laying at present. Caterpillars and pupæ are still to be found. An examination of a cane field that had been burnt, after the canes had been cut, revealed the fact that caterpillars in the roots remain uninjured. In connection with visits paid to the Naparima and Chaguanas Districts it was ascertained that comparatively few canes were attacked by the Cane-sucker caterpillar.

Frog-hoppers.—From materials sent to a Specialist for determination it appears that there are three distinct species and one variety of Frog-hopper in Trinidad, viz.:

1. *Tomaspis rubra*, var. *sororia*, Germ.
2. *Tomaspis pubescens*, Fabr.
3. *Tomaspis postica*, Walk.
4. *Tomaspis postica* var., Walk.

T. pubescens is rare, *T. rubra* is generally found about cocoa estates all over the island in small numbers, *T. postica* and its variety are the species causing damage to the canes.

Visits paid to Petit Morne Estate and Woodford Lodge Estate revealed the fact that Frog-hoppers in the nymphal and adult stages were present in small numbers. No eggs could be found. The canes in the field of Petit Morne Estate had recovered from an attack last year, and the young stages of the Frog-hopper were principally found on grass roots. The Chaguanas field was one that had not recovered from the attack last year, and had been abandoned and was overgrown with tall grass. The canes were sickly. Frog-hoppers were collected from the grass and canes.

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* "Since identified as a species of *Sarcodexia* family Sarcophagidæ.'

The collecting of data and material is still going on, but no definite conclusions with regard to Frog-hoppers have been arrived at yet. It is likely that as the dry weather increases Frog-hoppers will disappear.

Information on Insect Pests.—Since the last report few enquiries have been made; this is, no doubt, due to the scarcity of insects during the dry weather now prevailing. A circular giving directions for collecting and forwarding insect pests has been submitted.

Collection of Economic Insects.—Insects of any importance are being collected and prepared, and will be put up for display and reference when the cases requisitioned for are received.

F. W. URICH,
Entomologist.

26th March, 1909.

143.—

(*Read at a meeting of the Board on 23rd April, 1909.*)

I beg to submit the following:—

Coconut Insects.—A visit extending over 3 days was paid to Cedros and Icacos. At Cedros, eggs of the "Bearded Weevil" were collected from two coconut trees in different parts of the Ste. Marie Estate, but in both cases the trees were affected by fungoid disease. No eggs could be found on healthy trees. At Icacos, traces of beetles were observed, and in this case the trees were also attacked by disease. Material was collected for examination by the Mycologist. On a visit to Laventille a search for beetle eggs on diseased and healthy trees yielded negative results.

Frog-hoppers.—Owing to the dry weather there were few frog-hoppers observed, but as soon as the rainy weather sets in, there is a likelihood of these insects making their appearance. With a view of destroying the first brood as soon as it occurs, I would suggest issuing a Circular asking Planters to keep a sharp look out for any increase of frog-hoppers that may come under their notice. A powerful lamp has been received and will be tried for destroying these insects as soon as an opportunity presents itself. At the opening of the rainy season a general increase of insects may be expected.

Cocoa Insects.—On the occasion of visits paid to different cocoa estates, a brown "cockchafer" (beetle) was observed eating the young leaves of cocoa shoots. Occasionally these beetles appear in sufficient numbers to attract attention, but I do not consider them very serious pests. By shaking the branches over an umbrella or sheet during the evening or morning numbers can be collected. They can also be destroyed by spraying the affected trees with Paris Green. Several species of small leaf-eating beetles belonging to the family of *Halticini* were collected from young cocoa leaves. Although they eat out holes in the leaves, they do not appear to do much damage. Their habits and life histories are now under investigation.

On a visit to the Newlands Estate, a rubber tree was observed to be infested by the Brown Scale (*Saissetia haemisphaerica*). It is a common scale about gardens in Port-of-Spain and is prolific. There appears to be little doubt that it was introduced into Newlands Estate on nursery stock. I would recommend, in order to avoid the spread of such insects, that all plants sent out to estates should be thoroughly fumigated before leaving the nursery, and in order to ensure the carrying out of this precaution, that the inspection of nurseries be embodied in some form in the Plant Protection Ordinance.

F. W. URICH,
Entomologist.

23rd April, 1909.

144.—

(*Read at a meeting of the Board on 26th March, 1909.*)

In connection with the specimens received from the Hon'ble H. L. Thornton, I beg to submit the following :—

Cacao.—From the material sent in, it is not possible to make a specific determination, but the little white, black spotted flies belong to the genus *Aleurodicus.* In the immature stages the body is like a scale, and generally covered with a mealy whitish secretion of wax. They are always found on the under surface of leaves. When numerous they can be quite harmful to plants. In the present instance it would appear that Nature is checking these insects, as quite a number of the pupa shells show holes from which parasites have emerged. I would be much obliged if the Hon'ble H. L. Thornton could send some more infested leaves freshly picked and packed in a cardboard box. The determination of the parasite is of importance. As a rule *Aleurodicus* does little damage in Trinidad.

A determination of the ant could not be made from the material sent in. Ants should be put into a small phial with methylated spirits when collected. If numerous the nests should be sprayed with Barrett's Resin Compound (*See* Proc. Agricultural Society 1907, page 113, for formula). Associated with the ants were mealy bugs, *Pseudococcus citri.* The Resin Compound would destroy these also.

Rubber Castilloa.—The scale insects on the rubber leaves are *Saissetia oleae* (Black Scale). If numerous, they should be sprayed with Resin Compound. In Trinidad these scales are generally attacked by hymenopterous parasites. Some more material would be useful to determine the existence of parasites.

F. W. Urich,
Entomologist.

1st March, 1909

145.—

(*Read at a meeting of the Board on 21st May, 1909.*)

I beg to submit the following:—

Coconuts.—On a visit paid to Mayaro and the Cocal further information was gathered in connection with the habits of the Bearded Weevil (*Rhina barbirostris.*) A female was observed in the act of oviposition on a tree affected by root disease. Eggs were found on diseased trees and it is interesting to note that on trees affected by bud rot, eggs were laid on the upper part while those suffering from root disease showed eggs not far off from the ground.

An apparently healthy tree, but one in a field badly drained was attacked by beetles. So far, I am of opinion that beetles prefer trees in a diseased condition. As the females gnaw the bark of the tree to deposit eggs, some stomach poison, or a tarring of the stems may be tried, but it would appear that cultural methods and treatment for fungoid diseases come first. From material collected, larvæ of this Weevil are being reared. A single tree was found to be attacked by a *Sphenophorus* beetle. The tree did not look healthy and it is of importance to know whether it was free of fungoid disease. On the whole comparatively few scale insects were observed on the leaves of the coconuts and a fair number of predaceous beetles were also present.

The species of scales present were *Aspidiotus destructor*, *Vinsonia stellifera* and *Icerya montserratensis.*

The two first may well be left to their enemies, but the last named did not appear to be attacked and it should not be allowed to increase. The leaves affected should be cut off and burnt.

Cocoa.—In the Sangre Grande district young leaves of cocoa showed signs of having been attacked by the usual leaf eating species mentioned in last month's report. In connection with some spraying experiments to be conducted by the Mycologist an insecticide for these insects will be tried.

Grasshoppers or Locusts.—Immature and apparently recently hatched specimens of this insect were received from Icacos. They were put in a breeding cage with a view of rearing them, but they are not getting on too well. I did not have an opportunity of visiting the locality affected. The working out of the life history of this species is to be recommended with a view of warding off future attacks and especially to discover the place and manner of oviposition

Froghoppers and Castnia licus.—No cane estates were visited during the period under review. Specimens of *Tomaspis postica* (cane froghopper) were observed in small numbers on a Cocoa Estate at Sangre Grande.

Mosquitoes.—In connection with Sir Rubert Boyce's visit some field and laboratory work in connection with mosquitoes was undertaken on his behalf.

Collection of Economic Insects.—Owing to the apparatus requisitioned for not having been received yet, little progress can be recorded.

F. W. Urich,
Entomologist.

17th May, 1909.

146.—

(*Read at a meeting of the Board on 18th June, 1909.*)

I beg to submit the following:—

Froghoppers.—Since the advent of the rains at the beginning of the present month adult froghoppers which were never absent from cane fields visited by me in the past, have become more numerous but are not present in sufficient numbers to cause damage. On the occasion of three visits paid to the Caroni estate both adult and young stages were observed. Through the courtesy of the Hon. W. G. Kay a wire netting cage twelve feet square by seven feet high was erected on a cane field of "first ratoons" on the Caroni estate. The object is to isolate a certain number of cane stools and keep them entirely free from froghoppers so as to compare them with plants left unprotected. Subject to the approval of the Board and with the permission of the proprietors I propose erecting similar cages in the Chaguanas and Couva districts. I would also ask to be allowed to erect another cage on the Caroni estate in order to study the life history of these insects under natural conditions.

Castnia licus.—These moths appear to be more numerous now, no doubt the damp weather causing them to escape from the pupæ. Full grown caterpillars were collected from a canefield in Caroni.

Cocoa.—Visits were paid to estates in the Guanapo and Cumuto districts. Several species of insects were collected and will be reported upon when the work in connection with the Froghoppers and Castnia licus is completed. During the next months caterpillars may be expected to make their appearance and Planters are requested to report any serious damage to cocoa that may come under their observation. Information with regard to the cocoa beetle (*Steirastoma depressum*) is also much desired with a view of determining the following:—1 Districts in which prevalent; 2 time (months) of appearance of adults; 3 age of trees attacked.

F. W. Urich,
Entomologist.

14th June, 1909.

147.—Reports of Mycologist.

(Read at a meeting of the Board on 21st May, 1909.)

To date my time has been spent in more or less preliminary work, such as, making ready for use as an office and laboratory a portion of a room at the Government Laboratory, putting in order the available apparatus, preparing culture media, etc. About eight days have been spent in visiting estates at Laventille, Sangre Grande, Cocal and Mayaro. At these places specimens of diseased trees were collected from which certain cultures have been made. The Agricultural Inspectors and others also have sent in various samples of diseased material which have been worked over.

The mycological and pathological work which I wish to undertake with your approval, may be divided into several classes as follows:—

1. Microscopical and cultural work to obtain life histories as complete as possible, of the fungus parasites of economic plants, especially cacao, coconuts, and sugar cane.

2. Inoculation experiments with pure cultures of these organisms in order to determine the exact nature of their parasitism.

3. Spraying and other experiments to ascertain the best methods for the control of various plant diseases.

4. Making a collection of the Trinidad fungus flora.

The work under Class 1 will be carried on at the Laboratory, while the inoculation experiments (Class 2) will be made at the experimental gardens and other suitable places. The work under Class 3 will be done on estates in various parts of the island.

I also ask your permission to be allowed to read in the manuscript all articles intended for publication in the Bulletin of Agricultural Information, which deal with mycological and pathological subjects.

Although Bordeaux Mixture is an excellent preventive of a certain class of plant diseases and has been highly recommended for the control of various cacao troubles no properly conducted experiments with it or other fungicides have been carried out in Trinidad. Without definite knowledge based upon such experiments it is unwise to recommend spraying to the general planter. In order to obtain accurate results upon which to base recommendations for the use of fungicides, I would like to carry out an experiment in spraying cacao, a scheme for which I herewith submit to you for approval.

I should like to have the names of all those who would be willing to have the experiment carried out on their estates in order that I might select the place most suitable for the work. In this selection several things must be considered such as, prevalence of disease, condition of trees, regularity of planting, water supply, accessibility, etc.

The experiment should be carried on for at least one year, or better two years, and a written agreement embodying the items set forth in the scheme should be made between the Board of Agriculture and the estate owner before the work is begun. At the suggestion of the Entomologist plots on which insecticides alone and in combination with fungicides will be used, have been included in the scheme.

No results of this experiment are to be published until it has been carried out for at least one year, though at the discretion of the Entomologist or Mycologist recommendations or suggestions as to the use of spray mixtures based on results obtained may be made from time to time.

Upon the completion of the experiment the formulas for insecticides, the effect of their use upon the trees as well as the results obtained in the

control of insect pests will be reported upon by the Entomologist; while the general spraying operations, mixing plant, apparatus, and methods of mixing fungicides will be described by the Mycologist who will also report upon the results from the use of fungicides.

As a spraying outfit has been purchased for use on the *River* estate, and if the experiment is not located there, I should like to spray a block of trees at that place, making it more of a demonstration than an experiment, though it might be divided into two or three different plots.

I also wish to make an experiment in the spraying of coconuts, a scheme for which will be submitted later on. Methods for the control of root and other diseases will also be taken up.

Cacao Spraying Experiment.—A block of 800 cacao trees in good bearing, located in a district where diseases are prevalent will be required for the experiment. The trees should be in good condition as far as pruning and culture are concerned and should be in fertile soil so that they will be able to mature a good crop of pods. The ground should be fairly level in order to facilitate spraying operations. The trees should be picked over just before the experiment is begun.

These 800 trees will be divided into 36 plots of 20 trees each, which will be sprayed according to the schedule below, while 4 plots of 20 trees each will be left unsprayed as checks:—

Plot	1—Bordeaux Mixture, 4-4-50	Sprayed every	2	weeks
,,	2 ,, ,, ,, ...	,,	3	,,
,,	3 ,, ,, ,, ...	,,	4	,,
,,	4 ,, ,, ,, ...	,,	5	,,
,,	5 ,, ,, ,, ...	,,	6	,,
,,	6 ,, ,, ,, ...	,,	8	,,
,,	7—Bordeaux Mixture, 4-4-50+2 lbs. Arsenate of Lead	,,	2	,,
,,	8 ,, ,, ,, ,, ...	,,	3	,,
,,	9 ,, ,, ,, ,, ...	,,	4	,,
,,	10 ,, ,, ,, ,, ...	,,	5	,,
,,	11 ,, ,, ,, ,, ...	,,	6	,,
,,	12 ,, ,, ,, ,, ...	,,	8	,,
,,	13—Self-boiled lime sulphur, 20-20-100 ...	,,	2	,,
,,	14 ,, ,, ,, ,, ...	,,	3	,,
,,	15 ,, ,, ,, ,, ...	,,	4	,,
,,	16 ,, ,, ,, ,, ...	,,	5	,,
,,	17 ,, ,, ,, ,, ...	,,	6	,,
,,	18 ,, ,, ,, ,, ...	,,	8	,,
,,	19—Commercial lime sulphur, 1-30 ...	,,	2	,,
,,	20 ,, ,, ,, ...	,,	3	,,
,,	21 ,, ,, ,, ...	,,	4	,,
,,	22 ,, ,, ,, ...	,,	5	,,
,,	23 ,, ,, ,, ...	,,	6	,,
,,	24 ,, ,, ,, ...	,,	8	,,
,,	25—Arsenate of Lead and Lime, 2-2-50 ...	,,	2	,,
,,	26 ,, ,, ,, ,, ...	,,	3	,,
,,	27 ,, ,, ,, ,, ...	,,	4	,,
,,	28 ,, ,, ,, ,, ...	,,	5	,,
,,	29 ,, ,, ,, ,, ...	,,	6	,,
,,	30 ,, ,, ,, ,, ...	,,	8	,,
,,	31—Contact Insecticide	,,	2	,,
,,	32 ,, ,, ...	,,	3	,,
,,	33 ,, ,, ...	,,	4	,,
,,	34 ,, ,, ...	,,	5	,,
,,	35 ,, ,, ...	,,	6	,,
,,	36 ,, ,, ...	,,	8	,,

The object of the experiment is to test in a commercial way the effect of fungicides and insecticides on cacao trees.

The amount of cacao gathered from each plot throughout the year will be recorded and an accurate account of the cost of spraying will be kept.

The beneficial or injurious effect of the mixtures upon pods, trees and flowers will be noted.

If it is found as the experiment progresses, that any of the mixtures are injurious to a serious extent, the solutions will be tried in a more dilute form, and at less frequent intervals. If injury to the crop still occurs the use of such mixtures will be discontinued.

Before the work is started a written agreement should be made between the Board of Agriculture and the estate owner embodying the ollowing points:—

1. The estate owner is to furnish to the Board for one year a block of 800 trees to be used for the spraying experiment.
2. No pruning, picking, cultivation or other operations are to be done on the experimental plot during the year without notifying the *Mycologist* or *Entomologist* at least a week in advance.
3. The estate owner will furnish the labour necessary for the spraying operations.
4. All the cacao from the plots shall belong to the owner and he shall pick over the plots at the proper time, but must notify the Secretary of the Board at least a week in advance of the picking time.
5. The Board of Agriculture will furnish all spraying apparatus, mixing plant, and materials for the experiment.
6. As all possible care will be exercised in the selection of materials, and in the making and applying of the spray mixtures, the Board of Agriculture cannot be held responsible if there is a loss of crop in any of the plots.

The cost of this experiment, exclusive of labour, may be roughly estimated as follows:—

Mixing plant consisting of platform, barrels, etc. ...	$25 00
Set of wheel and frame for mounting barrel outfit...	10 00

Materials:

560	lbs. blue stone @ 7c.	39 20
1 120	,, lime @ 1c.	11 20
560	,, flowers of sulphur @ 3c.	16 80
250	,, arsenate of lead @ 12c.	30 00
100	gallons commercial lime sulphur @ 24c. ...	24 00
	Contact insecticide	5 00
	Total	$161 20

Respectfully submitted for approval.

JAMES BIRCH RORER,

Mycologist.

148.—

(*Read at a meeting of the Board on 18th June, 1909.*)

In pursuing the different lines of pathological and mycological work outlined in my first report, during the past thirty days my time has been about equally divided between field and laboratory work.

In the laboratory the endeavour is being made to obtain pure cultures of various parasitic and other interesting fungi, and success has already been obtained with a number of them.

Inoculations on healthy plants have been made with some of them and notes are being made on the results.

Most of the time in the field has been spent in visiting cacao estates for the purpose of selecting the places most suitable for the carrying out of spraying experiments and demonstrations.

The estate of Mr. Brown at Four Roads would be well suited for the experiment outlined in my last report and I think that satisfactory arrangements may be made with him, so that the work could be carried on there.

Plans for a spraying demonstration at Guanapo have been made with Mr. Maurice Lange. A solid block of a thousand trees will be sprayed with Bordeaux Mixture at intervals of from four to eight weeks throughout the year while an adjacent block of a thousand trees will be left unsprayed as a control. Mr. Lange himself proposes to spray eight thousand trees in the same field with a ready made Bordeaux Mixture which he has imported from France. The portion of the estate in which this work will be done is very near the railroad station, the trees are in excellent condition and in good bearing, and the land is rich and well drained. In all ways it is the most suitable place which I have seen for the conduct of a spraying demonstration.

Two visits in company with Mr. Urich have been made to the sugar estate at Caroni. Root disease was found to be present in more or less abundance in several of the fields. About sixteen stools of first rattoon cane, some, if not all of which are infected with the root fungus have been inclosed in an insect proof cage twelve feet square and six feet high. The canes thus inclosed will be examined every two or three days and will be kept free from Frog Hoppers throughout the season. These insects are already abundant on the surrounding canes. I think that it would be advisable to erect two or more cages in different fields at Caroni or perhaps in other infested districts, though the work should not be too much scattered.

Respectfully submitted.

JAMES BIRCH RORER,
Mycologist.

12th June, 1909.

149.—

(*Read at a meeting of the Board on the 18th June, 1909.*)

IN addition to my report submitted on June 12th, I ask that action be taken on the following supplemental report at your meeting to-day.

I spent Saturday afternoon with Mr. J. Brown at his estate near Four Roads, and as previously stated found that it was well suited for a spraying experiment. Mr. Brown is quite willing that the work should be done there, but insists that the whole expense of carrying on the work, as it is of an experimental nature, should be met by the Board. In the scheme submitted to Mr. Brown it was suggested that he furnish the labour necessary, but he is unwilling to do this.

I again visited Mr. Lange at Guanapo yesterday and made the final arrangements with him for a spraying demonstration. All that is necessary is your approval and the first spraying will be made next week. Mr. Lange will furnish all the necessary labour but I would suggest that the Board furnish the materials. As stated before a block of 1,000 trees will be sprayed and a similar block left unsprayed. Mr. Lange is willing that the work be carried on there for two or three years.

I think that a similar demonstration should be carried on at one other estate at least, perhaps in another section of the island.

I have visited Soconusco estate in the Santa Cruz Valley, and think that a very interesting demonstration could be made there on some of the very old trees and adjacent young trees. Mr. Louis Seheult at Cumuto, Mr. Murray at Sangre Grande, Mr. de Gannes at Arima and Mr. A. V. Stollmeyer in Santa Cruz have all expressed a desire to have some spraying work done on parts of their estates.

In carrying out our work both Mr. Urich and I would be helped if we could have an assistant to look after the breeding and laboratory work while we are in the field. It is very essential to have some one to do this if we are out for more than a day or two at a time. Mr. Urich and I have talked with Mr. Caracciolo, Junior, and have found him very keen for the work, especially the Mycological side of it. He has had one year at Wye, and judging from his notes has profited well by his course. Professor Carmody tells me that he also could find work in translating for Mr. Caracciolo to do in his spare time. At present I have no room in which he could work, but as soon as a suitable place can be provided for him, I beg leave to ask that he be appointed an assistant.

JAMES BIRCH RORER,
Mycologist.

18th June, 1909.

150.—Minutes of the Board's meeting.

At a meeting of the Board of Agriculture, held in the Council Chamber (Government Buildings), on Friday the 23rd April, 1909.

Present:

HIS EXCELLENCY THE ACTING GOVERNOR (President) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President.)
,, Hon'ble G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, ,, CARL de VERTEUIL.
Lieut.-Colonel J. H. COLLENS, V. D.
Mr. E. ANDRE.
,, BERT de LAMARRE.
,, L. de VERTEUIL.
,, WILLIAM GREIG.
,, J. J. McLEOD.
,, J. MOODIE.
,, H. E. MURRAY.
,, L. SEHEULT, B. SC.
,, J. H. WADE.
,, A. E COLLENS (Secretary).

Confirmation of Minutes.

The Minutes of the previous meeting having been printed and circulated among the members, were taken as read and confirmed.

Mr. Carruthers.

His Excellency mentioned that in a despatch from the Right Honourable the Secretary of State for the Colonies it was stated that long leave

of absence could not be granted to Mr. Carruthers as the Government of Trinidad was anxious to have his services as soon as possible.

Expenditure. The total expenditure to date amounted to $1,041 86.

Reports. The following reports were read:—

(1.) Report of Advisory Committee in which the following recommendations were adopted:—

(*a.*) The salary of the Mycologist to be paid in full from the 5th April.

(*b.*) Actual stabling expenses to be reimbursed to the Agricultural Inspectors.

(*c.*) Actual travelling expenses to be paid to the Board's Officers.

(*d.*) The erection of a small movable culture room for the Mycologist at the Laboratory, to be paid out of the Board's Funds.

(*e.*) That the Hon'ble R. S. A. Warner, K.C., be appointed on the Advisory Committee.

(2.) Monthly Report of Entomologist. Ordered to be printed in the Bulletin.

(3.) Half-monthly reports of the Agricultural Inspectors. Ordered to be printed in the Bulletin.

The Secretary informed the Board that advertisements had been placed in the daily papers, offering the services of the Inspectors free of charge, and that an Official circular had been issued to the Wardens notifying them of the appointment of Messrs. Brunton and Plummer as Agricultural Inspectors, and also as Plant Inspectors under Ordinance 127.

(4.) Report on Mynah Bird by Director of Agriculture, Mauritius.

It was decided not to recommend the importation of this Bird.

(5.) Report on Quarterly visit to Tobago (November) by Actin Superintendent.

Laid on the table.

Proposals for Agricultural Education. Proposals by the Vice-President for a system of apprentices in Agriculture, and also a scheme for Education and Examinations in Practical Agriculture were read. It was decided that the paper be printed and the matter submitted to the Board when a Committee would be appointed to deal with the proposed schemes.

Veterinary Report and valuation of Stock at the Government Farm. A proposal by the Acting Manager of the Government Farm that an independent valuation of the Stock should be made for the Annual Report, and also an examination of their condition by the Government Veterinary Surgeon was approved. Messrs. Bert de Lamarre, J. Arbuckle, and J. McInroy were appointed a Committee to make the valuation.

Importation of materials for Agricultural purposes—Duty free. The question of the importation of certain materials for agricultural purposes, free of duty, was referred to the Advisory Committee.

Fumigation of plants imported and exported. The question of the fumigation of all plants imported or exported was considered, and it was decided to refer the matter back to the Director for specific recommendations and details of expense.

A petition from Cacao Proprietors in Maraval with respect to the destruction of cacao pods by rats was read. The Board decided to send one of the Inspectors to report on the damage and suggest remedial measures. **Destruction of rats.**

The Vice-President stated that he had received 24 tubes of rat virus prepared locally by the Government Pathologist with the sanction of the Surgeon-General, and was in correspondence with the Surgeon-General with regard to future arrangements. He had also received several letters from the Danysz Virus Co., but the terms and conditions imposed precluded the favourable consideration of their proposals.

A paper by Mr. W. E. Jardine on "The natural regeneration of worn out cacao soils" was ordered to be printed and circulated. **Regeneration of worn out cacao soils.**

The following correspondence was dealt with:— **Correspondence.**

(1.) Despatch from the Right Honourable the Secretary of State for the Colonies relating to countries adjudged to be bounty fed.

(2.) Letter from Secretary, Chamber of Commerce, Ecuador, requesting information on cacao production in Trinidad and enclosing an article on "Cacao Producing Countries No. IX Trinidad" in El Diario de Ecuador. The matter was referred to the Cacao Committee to be dealt with.

(3.) British Guiana proclamation forbidding importation of diseased, or insect infected, canes from other cane growing countries except under certain conditions.

(4.) Letters from Director of Science and Agriculture, British Guiana, *re* further supplies of seedling canes, and from Colonial Secretary, Queensland, announcing that the Boadilla canes would be forwarded in March.

It was decided that these canes should be planted at Valsayn.

(5.) Letter from the Warden, Tacarigua, suggesting that much of the diseases of cacao was contracted from the Bocare Immortel, and requesting services of an Inspector to investigate the matter.

(6.) Applications from

(*a.*) Mr. Howard for post of Assistant Director.

(*b.*) Colonial Secretary, Ceylon, *re* Mr. Petch.

(*c.*) Mr. G. De Silva for services of Agricultural Inspector.

(*d.*) Mr. G. F. Huggins and Mr. P. Urich for services of Mycologist and Entomologist.

It was decided that Mr. Howard and Mr. Petch be informed that the vacancies in the Staff had been already filled; and that arrangements be made for the inspection required by Messrs. de Silva, Huggins and Urich.

(7.) Offers of cacao lands at Couva and Caparo for experimental purposes from Messrs. Madoo and W. H. Mills.

It was decided that these applications should be considered when schemes for this class of experiments had been formulated by the Advisory Committee. In the meantime the offers received would be noted.

(8.) Catalogues of Sprayers from Goulds Manufacturing Co., New York, and of "Siphonia" Sprayers and other Agricultural Implements from the Mayfarth Co., London and Berlin.

Acting Manager—Government Farm.

The Vice-President announced that the Right Hon'ble the Secretary of State for the Colonies had been pleased to sanction the recommendation of the Board that Mr. McInroy's acting appointment as Manager of the Government Farm should continue for another 12 months.

Amendment to Plant Protection Ordinance.

With regard to the proposed amendment of the Plant Protection Ordinance recommended at the meeting of the 8th January, the Hon'ble Attorney-General had stated that this would necessitate a great many alterations, and it was decided that a new Ordinance should be introduced similar to one now in force in the Federated Malay States.

Appreciation of Sir Neville Lubbock.

The following resolution of the Vice-President, seconded by Mr. Bert de Lamarre in appreciation of the services of Sir Neville Lubbock was unanimously adopted with applause:—

> That the Board of Agriculture at its first public meeting desires to record its sense of the services rendered to the West Indian Colonies by Sir Neville Lubbock, K.C.M.G., during his long period of office as Chairman of the West India Committee.

Adjournment.

The meeting then adjourned to Friday, 21st May, 1909.

A. E. COLLENS,
Secretary.

151.—Minutes of the Board's Meeting.

At a meeting of the Board of Agriculture, held in the Council Chamber (Government Buildings), on Friday, the 21st May, 1909.

Present:

HIS EXCELLENCY THE GOVERNOR (President) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President).
The Hon'ble R. S. A. WARNER, K.C.
,, ,, G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, ,, CARL de VERTEUIL.
,, ,, WM. KAY.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. BERT de LAMARRE.
,, J. D'ABADIE.
,, L. de VERTEUIL.
,, WILLIAM GREIG.
,, J. J. McLEOD.
,, J. MOODIE.
,, H. E. MURRAY.
,, L. SEHEULT, B. SC.
,, E. L. SELLIER.
,, J. H. WADE.
,, A. E. COLLENS (Secretary).

Welcome to His Excellency.

Before commencing the regular business, the Vice-President stated that he had been deputed by the Committee which met that morning to offer His Excellency a hearty welcome to the Colony and as President of the Board of Agriculture.

His Excellency replied that he appreciated the compliment and had much pleasure in becoming President of the Board.

Confirmation of Minutes.

The Minutes of the previous meeting having been printed and circulated among the members, were taken as read and confirmed.

Communications from Messrs. Bain and André, regretting their inability to attend, were read. Absent Members.

The total expenditure to date amounted to $1,559 91. Expenditure.

Mr. Scheult suggested that details of the expenditure incurred should be supplied to Members. His Excellency stated that the books of accounts were always available to Members, and that at present expenses were chiefly for salaries, but details would be furnished at any time to any Member requiring them.

The following recommendations of the Advisory Committee were approved:— Recommendations of Advisory Committee.

1. That a definite form of agreement be entered into between the Mycologist and the Board.
2. That the Collector of Customs be requested to consider the recommendation of the Committee that, sprayers, resin oil, and copper sulphate, be allowed to be imported duty free, and to express his views thereon.

   The Secretary was instructed to write to the Collector informing him of the above recommendation.
3. That the Agricultural Inspectors should next visit any of the older districts that may be agreed upon.
4. That a Committee composed of Mr. V. X. de Verteuil, Mr. E. André, and Mr. W. Greig, as Chairman, be appointed to enter into and consider the drafting of an Ordinance for the prevention and spread of plant diseases due to insects and fungi.

   Mr. Greig agreed to serve on the Committee, but not as Chairman, and it was decided that the Secretary should write to Messrs. André and de Verteuil inviting them to serve on the Committee.
5. That chairs should be provided at the Botanic Gardens on days when the Band plays, for those who are willing to hire them.

After discussion it was decided that the matter might be given by contract to some firm who would be willing to make the necessary arrangements.

The following monthly reports were then read and ordered to be printed in the *Bulletin*:— Reports.

Report of Entomologist.
Report of Mycologist.
Report of Agricultural Inspectors.

The Board approved of the payment of $36 39—the cost of a culture room for the Mycologist at the Laboratory. Approval of expense incurred in erecting culture room.

Further recommendations were proposed by the Vice-President in connection with the scheme for education in Practical Agriculture. Suggestions were made by Mr. Fenwick, and His Excellency appointed the following Committee to deal with the matter:— Agricultural Education recommendations.

The Vice-President (Chairman).
The Hon'ble S. Henderson.
,, Carl de Verteuil.
Mr. L. Scheult.
,, J. Moodie.

Mr. Bert de Lamarre recommended that the Law relating to Patents in Trinidad be amended in accordance with the Law in force in England to prevent any one from registering as a patent any manufacturing process which was already in operation, or copied from text books, or Mr. Bert's motion *re* Patent Laws.

other publications, and that a Committee be appointed to advise the Registrar-General as to the validity of applications.

The consideration of the question was postponed pending an expression of opinion from the Attorney-General to whom the subject had been referred.

Information required by the Secretary, Chamber of Commerce, Ecuador.

The Secretary stated that so far he had only received one reply from the Members of the Cacao Committee in answer to a Circular issued asking for information as to the Cacao production of Trinidad.

CORRESPONDENCE.

Correspondence.

1. A letter from the Warden of Tacarigua to the Hon'ble Colonial Secretary relating to a recent decision against the Manager of *Caroni* Estate for infringement of the Fire Ordinance, and also correspondence from the Manager was referred to the Board for an expression of its views. Mr. Kay stated that the Warden's proposal to grant a license for 14 days would meet the difficulties experienced by the *Caroni* Estate. It was also stated that the Ordinance was unworkable in connection with the burning of diseased plants. After discussion the Board requested Mr. Aucher Warner to draft amending clauses to the Ordinance so as to make it applicable to the new conditions that had arisen in connection with steam ploughs and diseased plants.

2. A Circular Despatch from His Lordship the Secretary of State for the Colonies enclosing the Report for December, 1908, of the British Delegate at the International Sugar Commission, was laid on the table.

Offer of Cacao lands from Messrs. Madoo and Mills.

3. Further replies were read from Messrs. Madoo and Mills stating conditions *re* their offer to the Board of lands for the purpose of conducting experiments in cacao cultivation. The Secretary was directed to write to Mr. Mills, stating that the Board had received his offer favourably, but regretted its inability to undertake at present any experiments in the planting up of a cacao plot. The Board regretted that it was unable to recommend at present any experiments under the conditions stated by Mr. Madoo.

Resignation of Capt. Wright.

4. The resignation of Captain R. K. Wright owing to his duties requiring his absence from the Colony for long and uncertain intervals was accepted.

The Secretary was directed to inform Captain Wright that the Board received his resignation with great regret and that his past services had been greatly appreciated by all the Members.

Stock Farm Valuation Committee.

5. The Secretary announced that Mr. J. Arbuckle had agreed to serve on the Committee for the valuation of the Stock on the Government Farm, and that the Committee had met on the 20th instant and had valued the Stock.

Use of Crude Petroleum in burning diseased material.

6. A letter from Mr. Greig dated April 25th was read stating that the Trinidad Petroleum Company had a stock of 100 (one hundred) tons of crude oil on hand which they were willing to dispose of at a cheap rate to anyone who required it for the purpose of destroying diseased plants; and suggesting certain aspects of coconut disease for investigation by the Entomologist and Mycologist.

Specimens exhibited.

The following specimens were exhibited —

(*a*.) Sample of sheet rubber from Major Walker, Tobago, sent through the Colonial Secretary.

(*b*.) Samples of different types of paper manufactured at the Tacarigua Factory.

(*c*.) Improved type of cacao knife patented by Messrs. D. C. Plummer and A. B. Carr.

Adjournment.

The meeting adjourned to Friday 18th June, 1909.

A. E. Collens,
Secretary (*pro tem.*)

152.—Minutes of the Board's Meeting.

At a meeting of the Board of Agriculture, held in the Council Chamber, (Government Buildings), on Friday, 18th June, 1909.

Present:

THE DIRECTOR OF AGRICULTURE, (Vice-President) *in the Chair.*
,, HON'BLE G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, ,, CARL DE VERTEUIL.
,, ,, W. G. KAY.
LIEUT.-COLONEL J. H. COLLENS, V.D.
MR. L. BERT DE LAMARRE.
,, J. D'ABADIE.
,, W. GREIG.
,, J. MOODIE.
,, H. E. MURRAY.
,, L. SEHEULT, B. SC.
,, E. SELLIER.
,, J. H. WADE.
,, A. E. COLLENS, (Secretary).

Confirmation of minutes.

The Vice-President announced that His Excellency the President had asked to be excused from attending the meeting unless there happened to be any subject of special importance on the Agenda; and that Mr. Ludovic de Verteuil had also written regretting his inability to be present.

The Minutes of the previous meeting having been printed and circulated among the members were taken as read and confirmed.

Expenditure.

The total expenditure to date amounted to $2,292 22.

Recommendations of Advisory Committee.

The report of the Advisory Committee was read and the following recommendations approved:—

(1.) With regard to the proposal made by the Warden of Savana Grande that the district should have a representative on the Board:—The Committee is strongly of opinion that there should be no representatives appointed for districts, that the present members represent industries and not districts, and that the Cacao Industry is fully represented already.

(2.) That the actual travelling and other expenses incurred by the Agricultural Inspectors should be refunded on production of vouchers, but this expenditure should not exceed more than $10 per month for each Inspector.

(3.) That further action should be taken to carry out the views of the Honourable Collector of Customs on the free admission of Articles used for Agricultural purposes, so long as the financial requirements of the Colony admit of it.

It was decided that the Advisory Committee should make definite recommendations, and confer with the Collector on this matter.

(4.) That as it may interfere with their field engagements, the Entomologist and Mycologist need not attend the meetings of the Board unless they happen to be in office and are notified to do so.

(5.) That it be brought to the notice of the Government that the house formerly used as the Superintendent's office in the Government House Gardens belongs to the Botanical Department, and inquiring whether it will be again available for the use of that Department.

(6.) That Mr. V. X. de Verteuil be invited to act as a member of the Board during the absence of the Honourable R. S. A. Warner.

The Committee reported that they had received the following offers:—

(A). To *River Estate.*

Three bags of Cacao Manure to be used for the experiments carried out at *River Estate*.

(B.) To any member interested in Coconut cultivation.

Two bags of Coconut Manure. The composition of the manures, the cost, and the amount to be used will be furnished.

Mr. W. Greig expressed his willingness to undertake the experiments in connection with coconuts, and to report the results to the Board.

Monthly Reports.

The monthly reports of the Entomologist and Mycologist and Agricultural Inspectors having been printed and circulated among the members were taken as read and ordered to be printed. A supplemental report of the Mycologist on suitable districts for conducting experiments in spraying was read.

After discussion it was decided that as the cost of spraying was so small, the experiments should be conducted on a larger scale in blocks or fields containing 10,000 to 12,000 trees, the yield from which has been known for some years previous, and that twenty trees was too small a number for determining the results of the experiments. It was also decided that the number of shade trees in each field should be counted and recorded. It was further agreed to recommend that spraying experiments be made on the following Cacao Estates:—

La Vega ...	... Hon. C. de Verteuil.
Soconusco ...	... Messrs. Wilsons Limited.
Verdant Vale	... Mr. J. H. Wade.
Wyaby McBean	... Mr. H. E. Murray

and on the Estates of Mr. Maurice Lange and Mr. de Gannes at Guanapo and Sangre Grande.

The Board expressed its appreciation of the satisfactory work of the Inspectors, and it was suggested that with the co-operation of the Wardens and Members resident in the districts the smaller proprietors might be invited to hold meetings at which the Inspectors would be present.

Appearance of Blight.

The Honourable S. Henderson announced that blight had appeared in part of one field in the Chaguanas District. It was decided that the Mycologist and Entomologist should visit the district and report.

Papers and Reports.

The following papers and reports were read:—

1. Results of analysis of soil from *Brooklyn* estate.

   The analysis of the *Brooklyn* soil shows that it is deficient in lime and phosphates and that the ratio of magnesia to lime is too high.

2. Results of analysis of Wild Pines—(*Aechmea nudicaulis*).

   These were analysed to see if they could be utilized as a mulch. The extent to which the sample, when cut small and exposed to the air, retained moisture indicated one of the useful features of mulches.

3. Results of analysis of seedling canes grown at the Government Laboratory.

   Some of these seedling canes showed a high percentage of sugar and high quotient of purity. It was decided to replant them at the Experiment Station.

   Mr. Henderson expressed a desire to obtain some of the cuttings.

4. Life and growth of a cacao pod—by the Honourable C. de Verteuil.

   This short contribution created a great amount of interest.

The following papers referred to the Board by the Honourable Acting Colonial Secretary were dealt with:—

1. Establishment of a Labour Bureau. Labour Bureau —M.P. 6733/08

Resolved:—(*a*) That without anything in the shape of a Vagrancy Act, and without any difficulty in obtaining employment by those who are really desirous of doing so, it is the opinion of the Board that the Establishment of a Labour Bureau would result in as complete a failure as the previous attempt at the Immigration Office;

(*b*.) but suggests that one be established for trial if it is found desirable to do so.

2. Draft of an Ordinance regulating the Truck System. Truck System —M.P. 3920/07

Referred to the following Committee:—

Vice-President—(Chairman).
Honourable Carl de Verteuil
Mr. Bert de Lamarre.
,, W. Greig.
,, L. Seheult.
,, J. H. Wade.

3. Honourable S. Henderson's motion *re* Tobago Stock Farm and the protest of the Planters' Association, Tobago, were referred to the following Committee:— Tobago Stock Farm.—M.P. 5899/08, 2744/09, 2982/09, 3253/09.

Vice-President—(Chairman).
Honourable S. Henderson.
Mr. J. D'Abadie.
,, E. L. Sellier.
,, J. H. Wade.

4. Report of Committee on *River* estate. *River Estate.* Experiments postponed.—M.P. 598/09.

His Excellency the acting Governor's Minute was read stating that there was no necessity to refer the question to His Lordship the Secretary of State, but that the matter could be brought up again when next year's estimates were being prepared.

The discussion on Mr. Jardine's paper on the natural regeneration of Cacao soils was postponed until next meeting. Mr. Jardine's paper.

The meeting adjourned till Friday, 16th July, 1909. Adjournment.

A. E. Collens,
Secretary (*pro tem.*).

I.

CASTILLOA ELASTICA AT NEWLANDS, TRINIDAD

Bulletin of Department of Agriculture, Trinidad.

VOL. IX. APRIL, 1910. No. 64.

Analyses of Tobago Soils.

THE following tables give analyses of soils, A, B, from Argyle Valley, and C, D, from Roxborough; the latter being old cane lands. C, having received a dressing of lime three months before the sample was taken.

The last two soils were cultivated as contracts for seven years before samples were taken, that means that a lot of provisions had been grown—corn, yam, sweet-potatoes, more than one burning that time—previous to contract these lands were in bush for several years I cannot find how long, and before that in Sugar Cane.

No manures have been applied by us and probably not in sugar times.

All the samples have been taken from cultivated land *i.e.* in cacao.

We cannot tell why there should be so much difference in Nitrates between C. D. C. was taken from sugar flat and had been limed three months before. D. is from same flat about ten yards away but had received no dressing of lime.

It is well known that lime assists nitrification; and the addition of lime to soil C. is probably the cause of the increase in nitrates shown by the analysis.

P. C.

	A. *Argyle Valley hillside.*	*B.* *Argyle Valley hillside ridges.*
Gravel	15·22	9·42
Coarse pebbles	3·32	2·44
Pebbles and coarse sand ...	5·22	4·26
Sand	2·58	3·88
Fine sand	3·04	4·00
Fine soil...	70·62	76·00
	100·00	100·00
The fine soil contains:—		
Water	5·80	5·62
Organic matter and combined water	7·50	8·20
Mineral Matter	86·70	86·18
	100·00	100·00

	A. *Argyle Valley hillside.*	B. *Argyle Valley hillside ridges.*
Composition of fine soil dried at 100° C.		
*Organic matter and combined water	7·962	8·688
Soluble silica	·425	·673
Oxides of Iron and alumina ...	17·907	21·734
Lime	4·119	3·293
Magnesia	·732	·731
Potassium oxide	·192	·145
Sodium oxide	·212	·249
Phosphoric anhydride ...	·108	·043
Sulphuric anhydride ...	Trace	·102
Chlorine	·003	·002
Insoluble silica and silicates ...	68·340	64·340
	100·00	100·00
* Containing:—Total Nitrogen	·184%	·157%
Available Plant Food.		
Potassium oxide	·0176 %	·0084 %
Phosphoric anhydride ...	·0265 „	·0114 „
Nitrogen as nitrates ...	·0073 „	·0013 „

	C.	D.
Water	4·40	6·42
Organic matter and combined water	10·40	9·96
Mineral	85·20	83·62
	100·00	100·00
Composition of samples dried at 100° C.		
*Organic matter and combined water	10·879	10·643
Soluble silica	·725	·764
Oxides of iron and alumina ...	23·471	23·107
Lime	1·816	1·921
Magnesia	·795	·840
Potassium oxide	·246	·270
Sodium oxide	·113	·150
Phosphoric anhydride ...	·065	·156
Sulphuric anhydride ...	·061	·111
Chlorine	·004	·003
Insoluble silica and silicates ...	61·825	62·035
	100·000	100·000
* Containing:—Total Nitrogen	·237%	·229%
Available Plant Food.		
Potassium oxide	·0074 %	·0102 %
Phosphoric anhydride ...	·0224 „	·0462 „
Nitrogen as nitrates ...	·0124 „	·0046 „

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

II.

FUNTUMIA ELASTICA AT NEWLANDS ESTATE, TRINIDAD

Rubber Cultivation in Trinidad and Tobago.

The increasing use of rubber, the probability of this continuing as civilisation progresses, and the abnormally large profits that have been and are being realised from rubber plantations that have come into bearing, have attracted the investor and it is now recognised that the cultivation is an extraordinarily profitable industry with every probability of permanence.

A few years ago the only sources of rubber were the native trees in the jungles of South America and Africa but within the last decade various rubber trees have been pressed into the service and have now taken their place as useful and remunerative cultivated plants.

Cultivated Rubber.

The chief of these is Para *Hevea braziliensis* the trees from which the highest priced rubber is obtained. Scores of millions of these trees have now been planted chiefly in the Eastern British tropical countries and have grown vigorously and have at an early age—from 4 to 6 years given large yields of marketable rubber of good quality.

Other rubbers have been cultivated with success though not so great as that of the eastern Para plantations. Of these, Castilloa *Castilloa elastica* is the most important and rubber of good quality and price has been obtained from trees of this species in Mexico and other countries.

Funtumia formerly called Kicksia has also been cultivated and good rubber extracted from this tree put upon the market.

These three plants are the only trees which have been planted in rubber estates in Trinidad, and as far as our knowledge goes at present are the best suited to local conditions.

The chief desiderata in the successful cultivation of rubber trees are climatic, the chemical constituents of the soil being as compared with the cultivation of other plants of relatively little importance. The ideal rubber climate, especially in the case of Para and Castilloa, is an equable high temperature and a constant rainfall without any period of drought. Seventy inches if distributed equally throughout the year is sufficient in most cases in some very porous and sandy soils this may be hardly enough for the maximum rapidity of growth.

Profits of Rubber Estates.

The unique success which has attended the planting of rubber in Malaya, Ceylon, and other countries, has naturally turned the attention of all interested in Tropical Agriculture to this cultivation, and no country where the climatic conditions are favourable to the growth of the plants whose rubber is already valued high on the market, would be wise to neglect consideration of rubber planting as an industry which may prove as it has done in the East far more profitable than any other agricultural venture.

There is little need to tempt the natural desire of the Tropical Agriculturist by mentioning the profits that have accrued from

rubber planting in Malaya and Ceylon. The wonderful results are now well known in Malaya where during the last eight years some fifty million trees or over 300,000 acres of land have been planted, many of the estates which are in bearing are paying 100 per cent. per annum on the capital expenditure on the fields which have already come into bearing.

The high cost of agricultural labour here necessarily means the adoption of different methods of cultivation from those of the countries with more favourable labour conditions. The practice which has produced such excellent results in the East of keeping the fields absolutely free from weeds by regular going round every ten days or a fortnight cannot, owing to the prohibitive cost on labour, be carried out here. The methods of tapping Hevea which obtain in Malaya and Ceylon require the careful shaving of the cuts on each tapped tree 120–180 times in the year.

Both these methods of rubber cultivation in the East are less suitable here, and other methods must be adopted to achieve if possible equal results. In the case of the weeding, I have for the last five years preached the adoption of the system of cover plants instead of clean weeding as being a method of saving a large proportion of the cost of bringing rubber into production without retarding the growth of the plants cultivated.

One of the chief objections in the East, is the dislike of the keen planter to fields which do not show what in his opinion is the sign of sound planting, viz., absence of all weeds. This objection does not exist in Trinidad as such fields are unknown and the nearest approach to clean weeding is that carried out on sugar estates, while in cacao plantations the weeds are merely kept back to some extent by the practice of "brushing," *i.e.*, slashing them down with cutlasses leaving the roots in the ground and scattering the seeds over the soil.

Plantations in Trinidad and Tobago.

Rubber planting in Trinidad and Tobago is in its infancy, and owing to lack of confidence or the necessary technical knowledge in cultivation and extraction of latex the progress has not been very rapid. There are at present in Trinidad some rubber trees of ages varying from one to fifteen years of the following species, and the following figures have been returned in answer to circulars from the Department:—

Hevea	...	...	80,000
Castilloa	...	...	600,000
Funtumia	...	...	25,000

It is not possible to compare the growth of these trees with those of similar age in Eastern plantations because in the latter countries the trees have been grown from their being planted as stumps, on clean weeded land and the height and girth under these conditions is much greater than in the case of trees surrounded by weeds or shading the soil with other trees and shrubs.

I have recorded very few measurements of trees in what is termed in the East "abandoned land" and this is unfortunate as these figures would be of use to compare with trees in Trinidad and Tobago which are growing either surrounded by weeds periodically "brushed," generally in association with Caçao, Erythrina (Bois

III.

CASTILLOA ELASTICA AT NEWLANDS ESTATE, TRINIDAD

immortelle) Banana and other plants. From general observations, however, I am of the opinion that the growth of Para rubber under the local conditions is very little if at all inferior to that of the trees of the same species in Malaya and Ceylon treated in the same way. Of the relative growth of Castilloa I have still less reliable data to form an opinion, but observations in different parts of Trinidad and Tobago lead me to the belief that Castilloa and Hevea (Para) grow equally well and vigorously here. It is true that in places Hevea seems to thrive more than Castilloa, but the reverse can be observed and I do not think there is any reason to suppose that taking the island as a whole either plant grows more vigorously than the other.

Hevea or Castilloa?

The decision for intending rubber planters as to which plant may be expected to prove more profitable is not easily settled. The chief arguments in favour of Hevea are that it grows vigorously on comparatively poor soils which are well drained. That the yields of rubber from trees already tapped, as far as they have gone compare favourably with those of similar age in other countries. That the method of extracting the latex from the Para rubber trees has been brought to a degree of perfection which though still capable of improvement is eminently satisfactory and practical. Against this, however, as previously mentioned is the argument that these methods of extracting the latex from Para involve a large amount of regular daily labour which we cannot hope to reduce by mechanical means.

That the rubber of cultivated Para trees has secured a high place on the markets of the world as a valuable rubber. and is in continual demand by the manufacturer. That the coagulation is easy and the preparation of dry rubber a well understood and easy process.

The arguments against Para as compared with Castilloa are, that the supply of seed locally is limited and importing them from the far East is by no means an easy or certain way of getting plants. That the plant when young is greedily eaten by almost all animals. I have seen many thousands of plants in a large nursery browsed down by a cow and deer, monkeys, pigs, &c., are very fond of the plant.

The arguments in favour of planting Castilloa elastica are to some extent more based on expectation than on exact data. The tree grows vigorously and in some cases when side by side with Hevea compares favourably with the latter. An almost unlimited supply of seed and young plants is available. The important question of probable yields is not an easy matter to express an opinion on. Large plantations of Castilloa exist in Mexico and other countries but figures of the yields as far as they are obtainable, do not show anything like the return which Hevea has given in Malaya and Ceylon. The differences in the returns from large areas in Mexico Castilloa and Malaya Para are enormous. In the latter County in one State, Negri Sembilan, 300,000 tapped trees gave an average of 2 lbs. 7 ozs., per annum while the highest Mexican figures on a sizeable area I have seen are $\frac{3}{4}$ lb.

The results of all observations and experiments which have been carried on in Trinidad and Tobago are most encouraging in regard to the amount and quality of the latex in the tissues of Castilloa trees of age and size, but the methods of extraction are at present by no means satisfactory. I carried on very few experiments or observa-

tions in extraction of latex from Castilloa when in the East of the planting of that tree not being considered as against Hevea.

Since my arrival in the West Indies I have been making many tentative experiments and observations as to tapping Castilloa, and am of the opinion that the methods which have been used for extraction of latex up to the present are unsuited to the structure of the tissue of Castilloa and the arrangement of its latex vessels. The use of the knife in Hevea causes little or no gaping of the wound, and the bark tissues can be cut smoothly and very thin. In Castilloa the fibrous character of the tissues make it difficult to cut clean or thin and there is always a widening of the wound which takes a long time to heal and is the potential harbourer of insects, fungi and other undesirables. For these reasons I am inclined to believe that if the latex can be extracted with minimum of wound to the tree, and at the same time by a process which can be done quickly, and is therefore labour-saving, a great advance will be made in the methods of tapping Castilloa.

TAPPING OF CASTILLOA.

BEING of opinion that the cutting or slicing of Castilloa bark was unsuitable, I began soon after my arrival a series of experiments on individual trees with sharp pointed weapons of differing dimensions, all of which were meant to penetrate right down to the old wood, with as small a puncture as possible.

Can the latex be so extracted with success? It is too early to be at all confident, but the tappings with various crude instruments I used at first gave excellent results per square inch of bark tapped. I have recently received from England a series of instruments made from my designs, in which the pricking points varying in size and length, distributed on rollers, can be forced into the bark making equidistant punctures all over the surface of the trunk.

When I have carried on a series of exact experimental tappings with these new tapping instruments and discover which of the pricking points is the most effective, and at what distance the punctures should be made, an account will be published in detail, and it is therefore not necessary here to go further into the question.

It would be premature to make any estimate of the quantity of the latex which may be expected from these pricking methods, but results on small areas of bark in one pricking have given yields which when multiplied by the difference between the area tapped and the area available amount to from $\frac{3}{4}$ to $2\frac{3}{4}$ lbs. per tree in one tapping.

It must, however, be explained in connection with these preliminary experiments over a small portion of the area of the tree that it is improbable that the whole area will give as much as the multiple of the amount recorded from the smaller area. In the latter some latex comes from an area outside the tapped and measured portion. Mr. Smith of Tobago, who has carried on experiments as to this method of tapping, supports this and informs me that a trial of the whole area on a tree in his estate showed a less amount than that obtained from a portion.

The question as to whether the maximum of latex can be extracted by pricking the whole as against treating a portion, say half or one-third, of the tapped area of the tree is one which must be determined and in a series of experiments which I have planned and

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CASTILLOA ELASTICA AT ROYAL BOTANIC GARDENS, TRINIDAD

which will be carried out by the permission of the owners on six different rubber plantations of tree of eight years and older, this problem will be I hope solved.

I hope that such experiments will be carried on by all planters having tappable Castilloa trees, and it will be of much assistance if any carefully recorded data as to yield by pricking or any other process can be sent to me. In order to get the best yields from the pricking method the tree must be occasionally sprayed with water during the tapping process until the latex ceases to flow, this will be found to largely increase the amount extracted, the holes by this means being kept open and the rubber not allowed to coagulate in them and thus stop any further flow.

My experience on this point has been that while the flow from punctures properly made and without spraying or watering will flow for some 15–25 minutes, if coagulation is prevented by applying water the flow will continue from 50–75 minutes and will result in some 30 per cent. to 40 per cent. more latex.

With regard to methods of planting I would strongly advise the planting of rubber by itself on the land and not in conjunction with other trees. Mixed cacao and rubber plantations rarely do justice either to the one or the other cultivation. The rubber should be planted in the open without any shade over it at all, and the method of planting stumps which has resulted in such excellent plantation of over 300,000 acres in Malaya will probably be found to be the best here. The stumps used are plants from the nurseries of six to eighteen months old from which the green portions have been cut and the roots roughly trimmed, the result being a stick of about ½ in. in diameter from 4 to 5 feet high. These when planted in the field in suitable weather should strike and produce leaves within a few weeks.

The field must be prepared for the rubber some months before they are planted and if it is virgin jungle the best method will be directly after it has burnt off to establish by sowing broadcast or by planting whatever cover plant is selected as the most suitable.

When once the cover plant is thoroughly established the field needs no more attention, and when the stumps are ready, and good planting weather is anticipated, they can be put out without materially disturbing the cover on the soil.

Distance of Trees.

As to the distance of planting like most agricultural problems admits of argument. The reasons against close planting *i.e.* 12 x 12 feet or closer (302 to the acre) are that it prevents the tree from growing to full vigour and to the greatest possible size, forcing it to run up to the light and giving no room for lateral branches. That it increases the cost of collection of rubber since a larger number of trees have to be tapped for the same amount of rubber. That if it is found necessary to give the trees more room the cutting out of a proportion of them is fraught with much danger to the remainder, inasmuch as each dead rubber tree root or portion of root is a potential centre of root disease fungal or insect. To plant more rubber trees than it is intended to permanently keep on the estate and afterwards by cutting out reduce the number is a dangerous

policy. All acquainted with diseases in plants will agree that to leave the dead roots in close proximity to roots of living trees of the same species is most likely to encourage root fungus and insect pests.

If a planter finds it necessary to give more growing room for the branches and leaves of some of his trees it is preferable to pollard some allowing them to grow slowly underneath the branches of the unpruned trees, rather than by cutting them out to leave the decaying roots dotted all over his fields. That the admission of sunlight freely as is possible in a plantation of rubber with trees 20 to 30 feet apart is a safeguard against the attacks of parasitic fungi.

The advantages claimed for close planting are that it gives for first years of tapping a much larger yield per acre. Evidence in eastern plantations point to this being true during the first four or five years but the additional cost of tapping and the probability that this result will not be so marked as the trees get older to a great extent modifies this reason for close planting.

I would have preferred to postpone the writing of these notes of rubber cultivation until I had more exact data upon which to base my opinions, but the number of queries with regard to the possibility of rubber in Trinidad and Tobago, both locally and from England, seem to necessitate some report as to the position up to the present. Our definite knowledge is at present very scanty, and accurate and reliable data must be gathered by exact observation and experiment. The position in regard to the rubber industry in Trinidad is not unsimilar to that which obtained in Ceylon and Malaya some ten years ago. The mass of statistics and observation which have been carried on by the scientific officials of these places as well as by intelligent and painstaking planters has given these countries an industry upon which they have exact knowledge, and the prospects and profit of which they can accurately gauge.

It is however certain that both Hevea Braziliensis (Para) and Castilloa elastica grow vigorously and yield latex in good quantity in Trinidad and Tobago. No data exists as to yields, only spasmodic tappings having been made and no rubber has been prepared but by the crudest methods, but all these attempts have been encouraging and contain no evidence that the trees of Trinidad and Tobago possess any less of the profitable characters than the Para and Castilloa trees of rubber-producing countries.

Future Experimental Work.

Through the kindness of Mr. Boos, I have had placed at my disposal for experimemtal purposes 97 Para rubber trees of 9 or 10 years old, averaging in girth at 3 feet from the ground 2 feet $10\frac{1}{2}$ inches, and at the base 3 feet $8\frac{1}{2}$ inches. I am making arrangements to carry on a continuous series of tappings every other day for two years or more, and all data of yields, quality of rubber, &c., will be carefully recorded.

I propose to begin a series of experiments on a large scale with Castilloa directly the experiments I am carrying on with a small number of trees have given some information as to the best shape of puncturing instrument and the most effective way of forcing it into the bark.

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HEVEA BRAZILIENSIS, NEWLANDS, TRINIDAD

For this purpose the estates below mentioned have placed plots of trees at the disposal of the Department of Agriculture and therefore while regretting the lack of information on important points which this paper show I hope that in the course of a few months the knowledge which we so much desire may be obtained. The planter who is at present waiting timidly on the bank will be encouraged to plunge and will also have figures to enable him to choose between the rival merits of Hevea and Castilloa :—

Santa Aneta	... Longdenville	... Mr. F. Boos.
Santa José	... Guaico	... Mr. J. G. de Gannes.
Verdant Vale	... Arima	... Mr. J. Wade.
Poole	... Savana Grande	... The Poole Estate Syndicate.
Richmond	... Tobago	... Captain Short.
Louis D'or	... Tobago	... Mr. T. W. M. Orde.
Monte Cristo	... Cumuto	... Mr. H. Monceaux.

The illustrations distributed through this issue show the various species of rubber cultivated in Trinidad. In all cases the plants have been grown without continuous weeding, and this factor should be taken into consideration in considering the size of the trees as compared to trees of the same species in other countries.

Plate	1—Castilloa elastica	... 6	years old.
,,	2—Funtumia elastica	... 3½	,, ,,
,,	3—Castilloa elastica	... 6	,, ,,
,,	4— ,, ,,	... 12	,, ,,
,,	5—Hevea braziliensis	... 3	,, ,,
,,	6—Funtumia elastica	... 12	,, ,,
,,	7—Castilloa elastica	... 20	,, ,,

J. B. C.

Preliminary Report on Cacao Spraying Experiments.

Although the cacao spraying experiments have not been carried on for sufficiently long a time to make general spraying recommendations possible, the Board of Agriculture has thought it advisable to give at this time the beneficial and harmful results which have thus far been obtained together with the methods and mixtures used.

In the latter part of July some preliminary sprayings for the purpose of learning the effect of various mixtures on flower buds, flowers, young fruits, and leaves were made both at Santa Cruz and Tumpuna, while the main part of the work was done later in one of Mr. Maurice Lange's fields at the latter place. As a preliminary test Bordeaux mixture of two strengths, 5–5–50 and 4–4–50, was tried as well as a proprietary lime-sulphur solution at various dilutions. Both strengths of Bordeaux mixture destroyed buds and flowers and injured tender leaves on young chupons to a slight extent; but even the very small fruits and older leaves were not injured at all. The lime-sulphur mixture, diluted as much as 1 to 25 was also injurious to buds and flowers but proved innocuous to leaves and fruits, while at a dilution of 1 to 30, the weakest solution tried, the buds were scarcely injured at all and a few flowers which were open at the time of spraying set fruit later on. This mixture still more dilute is now being tried and may prove a valuable spray for cacao. A self boiled lime-sulphur mixture is also being tried. The injurious effect of the Bordeaux mixture was doubtless aided by the climatic conditions following the spraying, for a great deal of rain fell so that the trees were wet for several days, and it is a well known fact that Bordeaux mixture is much more injurious in wet weather than in dry.

For the experimental work on a somewhat larger scale a block of one thousand trees was selected and divided into two equal parts. The two plots of five hundred trees thus formed were as nearly alike as possible in all respects. The trees were of the same age, and the drainage, soil, and shade conditions of each plot was identical. Moreover two pickings which were made before any spraying was done gave practically the same amount of cocoa from each plot, and the relative proportion of black to good cocoa from each was the same. Plot 1 was sprayed on September 6 and 21 with Bordeaux mixture, 5–5–50 formula, while plot 2 was left unsprayed as a control. The spraying was done with a barrel pump fitted with two 75 foot leads of hose and 8 foot bamboo extension rods with double vermorel nozzles. An endeavour was made to spray each tree thoroughly including leaves, pods, trunk, and branches. At the time of the first spraying the trees were well laden with young fruits from ½ to 3 inches in length and bore a few older pods. A small picking from the plots was made in September and the yield from each was the same, as was to be expected, for it was too soon for the

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FUNTUMIA ELASTICA, EXPERIMENT STATION, TRINIDAD

spraying to have had any effect. The two main pickings were made on November 12 and December 11. The fruit from each plot was piled separately, counted, and sorted into sound and black cocoa. The term "black cocoa" is used here in the general way and means pods which have been so attacked by fungi that the beans have been affected. Pods in which the rot started from bird, squirrel, or deer injury were not considered black cocoa in the count. Such injury was about two per cent. of the total number of pods picked. Detailed descriptions of various types of black and brown rots and canker of pods and of the causative fungi are in preparation for future publication. The results of the counts are shown in the following table :—

Plot numbers and treatment.	Pods Picked.	Total Nnumber.	Sound Pods.	Black Pods.	
				Number.	Per cent.
1. Sprayed Sept. 6 and 21 ...	Nov. 12 ...	1942	1726	216	11·1
,, ,, ,, ...	Dec. 11 ...	1277	1204	73	5·7
Total	...	3219	2930	289	8·9
2. Control, no treatment. ...	Nov. 12 ...	2064	1404	660	32·0
,, ,, ,, ...	Dec. 11 ...	1040	778	262	25·2
Total	...	3104	2182	922	29·7

From a study of the table it will be seen that there has been a gain both in the total number of pods and in the number of sound pods from the trees of plot 1. As a result of this gain the 500 sprayed trees yielded 189 pounds more of good wet cocoa than the unsprayed trees.

Although these results alone are not sufficient to make it possible as yet to give definite spraying recommendations, they show that the amount of black cocoa can be appreciably reduced by the use of Bordeaux mixture. Moreover both Bordeaux mixture and lime-sulphur solutions kill moss completely so that hand mossing is not necessary on sprayed trees: and again, trees sprayed with these fungicides are doubtless less liable to canker infection than unsprayed trees.

Method of Preparing Bordeaux Mixture.

It is essential that Bordeaux mixture be properly made to get the best results from its use. The necessary ingredients are copper sulphate or bluestone, temper lime, and water. The greater part of the commercial bluestone on the market here is suitable for spraying purposes. It should be obtained in either the crystal or granulated form; any which has a greenish substance mixed with it in appreciable quantities should be rejected. Great care should be taken to use only fresh temper lime. It can be got in barrels holding about 180 pounds or in smaller kegs. Soft water makes the best mixture, but for practical purposes any water which does not contain much mud or grit may be used.

Various strengths of Bordeaux mixture may be made. For general work it is perhaps best to use a mixture containing an equal quantity of bluestone and lime. In the experiments here the 5-5-50

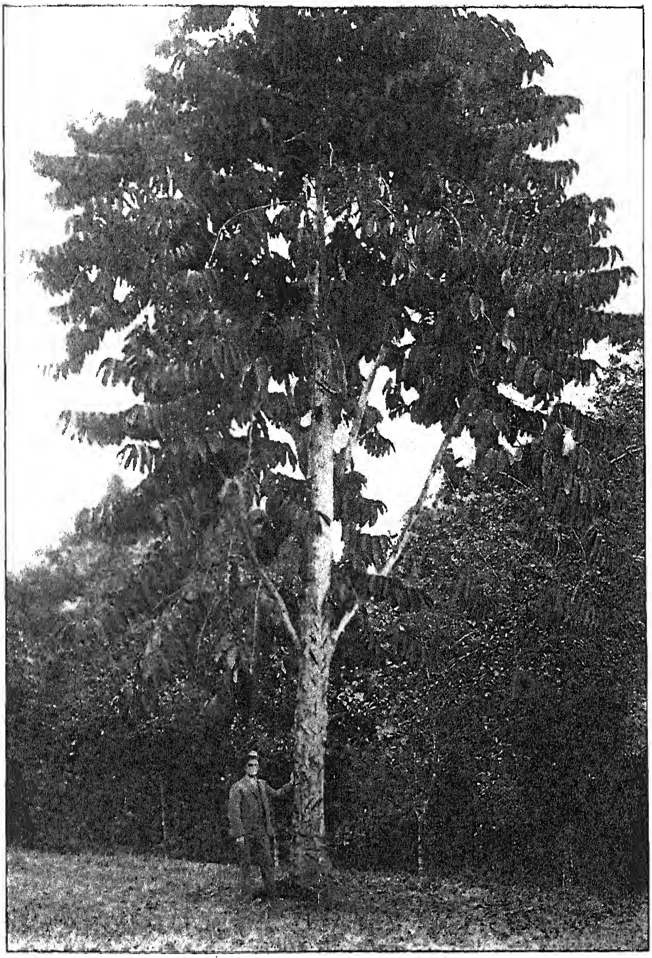
formula has been used, that is to say, 5 pounds of bluestone, 5 pounds of lime, and 50 (American) gallons of water. A barrel of mixture after this formula should be made as follows :—Dissolve the bluestone in 25 gallons of water in a half-barrel or other suitable vessel; slack the lime in a similar vessel, and when thoroughly slacked and worked into a paste dilute with water to 25 gallons. Then pour the two solutions together simultaneously into the spray tank or other vessel. The mixture thus made will be a beautiful sky blue colour and creamy in consistency. It should be kept thoroughly agitated and used as soon as made, though the separate bluestone and lime solutions may be kept indefinitely. Where spraying is done on a large scale it saves much time to make up stock solutions of bluestone and lime. Fifty gallon barrels or puncheons of larger capacity can be used for holding these solutions. The bluestone stock is made by dissolving a given number of pounds of bluestone in the same number of gallons of water. This is best done by filling with water a 50-gallon barrel, if such is to be used, and suspending in it *near the top* a bag containing 50 pounds of bluestone. This will dissolve in about two hours. Each gallon of this solution will contain one pound of bluestone.

A stock solution of lime is made by slacking 50 pounds of lime in a barrel, and, when thoroughly slacked and worked into a paste diluting with water to 50 gallons. Each gallon of this mixture will contain one pound of lime. To make one hundred gallons of Bordeaux mixture of the 5-5-50 strength it is only necessary to take ten gallons from each of the stock solutions, after stirring them thoroughly, put into separate vessels and dilute each with water to 50 gallons. The whole of these dilute solutions, or equal portions of them as required, may then be poured together simultaneously through a strainer into the spray tank or other vessel. The strainer should be made of brass wire gauze of about 20 meshes to the inch. The thorough straining of spray mixtures is very essential in order to avoid the clogging of the nozzles with particles of lime or dirt.

The lime for Bordeaux mixture must be slacked carefully. The required amount of temper lime in lumps should be placed in the bottom of a barrel and enough water should be added to half cover it. The lime will soon begin to slack. More water must be added, a little at a time, and the mixture stirred constantly with a long handled shovel or other suitable implement. Too much water added at one time drowns the lime, while too little allows it to burn. When properly slacked it will be in the form of a smooth thick paste containing very little granular matter. Not more than 50 pounds can be well slacked at one time, and until the knack of working it is mastered it is better to start with 25 pounds or less at a time.

If possible it is best to get temper lime for spraying purposes in rather small quantities as it deteriorates very rapidly through air slacking, but if three or four hundred pounds are purchased at a time it should all be slacked as soon as received from the kiln. It may be slacked in 50 pounds lots, diluted with a certain amount of water and kept as a stock solution in barrels or large puncheons. In using such stock solutions it is only necessary to know the relative

VII.



CASTILLOA ELASTICA IN ROYAL BOTANIC GARDENS, TRINIDAD

proportion of lime and water and a Bordeaux mixture containing any amount of lime can be made. If a stock solution of either lime or bluestone is allowed to stand for sometime a certain amount of evaporation will take place. Before using such solutions water should be added to make up the original quantity. The necessity of using good lime for Bordeaux mixture cannot be too strongly emphasized as not only the fungicidal value of the mixture but its sticking quality as well is greatly influenced by this factor.

Bordeaux mixture may be tested either with a steel knife blade or with a 10 per cent. solution of yellow prussiate of potash, but testing is never practiced in commercial operations and is not at all necessary if the lime used is of good quality and a quantity equal to the amount of bluestone is used. The object of the test is to ascertain whether or not all of the bluestone has combined with the lime, as uncombimed bluestone solution is injurious to plant tissues. If there is free bluestone in the mixture a slight deposit of copper will be seen on the knife blade after a short immersion in it; or a dark brown precipitate will be formed when a drop of the potash solution is added to the mixture. To the practised eye however the colour of the mixture alone is a sufficient guide, for if there is free bluestone present the mixture will have a distinct greenish tinge, while a neutral mixture or one containing an excess of lime will be sky blue. Bordeaux mixture must always be kept thoroughly agitated while being used.

Any inquiries in regard to spraying will be gladly answered by the writer.

James Birch Rorer,

Mycologist.

Since the above Preliminary Report on Cacao Spraying Experiments has been set up in type two more pickings have been made from the sprayed and unsprayed plots at Tumpuna. The results of the picking of January 14 were reported at the meeting of the Board of Agriculture on January 21, but the counts from that of February 15 are given here for the first time. The table already given, embodying the results of the earlier pickings, shows that the chief effect of the spraying was simply the reduction of black cocoa on the sprayed trees. This was again true in the more recent pickings, but in addition more pods were gathered from the sprayed trees. The following table shows the results of the pickings of January 14 and February 15 :—

Plot numbers and treatment.	Pods picked.	Total Number.	Sound Pods.	Black Pods.	
				No.	Per cent.
1. Sprayed Sept. 6 and 21 ...	Jan. 14 ...	1,843 ...	1,713	130	7·0
,, ,, ,, ...	Feb. 15 ...	986 ...	964	22	2·2
Total	...	2,829	2,677	152	5·4
2. Control, no treatment ...	Jan. 14 ...	1,159	881	278	23·9
,, ,, ...	Feb. 15 ...	470	427	43	9·1
Total	...	1,629	1,308	321	19·7

From this table it will be seen that from the sprayed trees 1,200 more pods were gathered than from the unsprayed. This marked increase in number of pods coming at this time points rather conclusively to the fact that these pods were saved from fungus attack when they were quite small for the sprayings were made from 4 to 5 months before these pickings, and the life of a pod is from 130 to 150 days.

To the present time 1,315 more pods have been gathered from Plot 1 than from Plot 2; 7·3 per cent. of the total number from the sprayed trees was "black," while 26·3 per cent. from the control trees was "black." Owing to the reduction of black cocoa on the sprayed trees, 2,117 more sound pods have been picked from Plot 1 than from Plot 2.

J. B. R.

February 26, 1910.

Froghoppers in Sugar Cane.

(Tomaspis postica, WALK.)

In this paper I propose dealing with the field work done during the past year and submitting recommendations for controlling this pest.

INTRODUCTION.

In dealing with Froghoppers and the "Blight" that they are generally associated with, the fact must not be lost sight of that no serious attention was paid to them until 1908, when it was recognized that Blight and Froghoppers had some relation to each other. In 1863 Dr. Herman Crüger, late Government Botanist, in an essay on Cane disease and pests mentions "an animal which I do not find mentioned "as one of the enemies of the cane in the books at my disposal is "very likely a species of *Delphax* but of a larger size than the "*Delphax saccharinara*. This I found on the roots of the canes and "rather numerous." No mention is made of the spittle surrounding the insects but as some other insects generally found on roots of canes are specifically mentioned I am inclined to believe that Crüger meant Froghoppers. In 1879 Mr. E. H. Francis, Government Chemist, in a paper on Blighted Sugar Canes from *Orange Grove* Estate mentions "Jumper flies" but otherwise deals with the chemical composition of the soil and puts "Blight" down to the nature of the soil. In 1889 Mr. J. H. Hart called attention to Froghoppers, but no remedial work against them was undertaken until 1906 when some spraying experiments were conducted at Couva. From above it will be seen that Froghoppers have been present on cane estates for a long time and no doubt have been increasing from year to year, occurring in destructive numbers whenever the weather was favourable for their increase.

FOOD PLANTS.

The original food plant of these insects is still doubtful, in fact from observation I am inclined to state that the Froghopper has a decided preference for grasses. Some species are preferred such as the so called "Savannah grass" of the cane estates, also Para grass. Young nymphs are generally found on the surface rootlets of grasses growing in the cane fields. Adults and advanced nymphs seem to like cane roots and leaves. Outside the cane estates I have seen adults feeding on low herbaceous plants, but I have always found nymphs on grass.

DISTRIBUTION.

The Froghopper is a fairly common insect in Trinidad. It is found on cocoa estates, in second growth of bush and there is not a cane field in this Island entirely free from it. Froghoppers like a certain amount of moisture and in consequence are found on low lying lands. In the northern range of hills they are fond of the valleys and live on the shrubs near the rivers. I feel almost certain that our froghoppers are indigenous to this Island and there is no likelihood of their having been imported at any time.

Life History and Habits.

Mr. McLeod in his very interesting paper describes the act of oviposition in confinement. I tried to confirm his observations in the field but I was not successful in finding eggs on cane leaves, cane or grass roots. It is possible that in Nature the eggs are scattered about by rain or that the female deposits them singly on rootlets on the ground. The smallest and most recently hatched nymphs are generally found on the small surface rootlets of grass. As they exhaust the sap from a root they move on to another and keep moving about until they find themselves on cane roots. If the weather is dry they frequent damp places and retreat either into cracks in the ground or down among the cane roots. They are particularly fond of going under so called "Boucans" in the cane fields. In these "Boucans" they seem to find ideal conditions for existence on the grass roots which, protected by the trash from the rays of the sun, grow well and numerously. Another favourite locality is on land that has been forked. They get under detached clods of earth through which grass roots grow. Fields of young plant canes generally get infected in this way. The mymphs thrive on the grass until the canes are big enough to support them. When a field is affected by root disease and there is trash sticking to the canes under which rootlets are sent out, the nymphs ascend the cane and find food and protection. As growth continues the nymphs shed their old skins in their enveloping mass of spittle and appear in new suits. They then change their feeding place leaving the old skin behind in their former abode. At each moult wings are gradually developed first appearing as little pads on the thorax. They pass through four or five different stages until they reach the final adult or winged stage. When about to change for the last time the nymph ascends for a foot or two a grass stalk or cane and in a kind of hollowed out chamber in the froth undergoes the final moult leaving the cast skin behind in it. These moulting chambers remain a few hours after the insect has escaped and they can be found in cane and grass fields. The last moult appears to take place in the morning. The nymphal period appears to occupy about 30 days, the stage before the final moult occupying the longest period. The adults after issuing from their spittle chambers crawl up a grass stem or cane and secrete themselves in the axils of the leaves or in the folds of unrolling leaves. For this purpose they are particularly fond of canes and in a severe attack as many as 3 to 6 can be found in each cane leaf. Here they remain with their legs drawn up close to their bodies in a state of rest until the late afternoon when towards dusk they crawl out and walk about on the cane or grass leaves. Many are seen feeding then while others take short leaps from leaf to leaf no doubt in search of mates as well as food. Some also feed during the day when secreted in the leaves. Their activity in this direction can always be traced by drops of water being seen near them. These are the results of their feeding operations which are so well described by Mr. McLeod. During the day many couples are found in coitu among the young unfolding cane leaves. They have crepuscular and nocturnal habits. Towards night I have seen them crawling about the ground. They go readily to light, but

owing no doubt to their habits of going down on the ground lights placed low down are most effective in catching them. I only know the egg from dissection of females. Each examined contained from 20–30 eggs well matured as well as undeveloped ones. Judging from the size of the nymphs found in the field oviposition seems to extend over a period of several months I doubt if it ever stops at all. There was no such thing as a well defined brood observed although at times in one or two localities nymphs predominated over adults.

Seasonal History.

No period of rest has been observed even in the dry season when insect life is at its lowest in this Island. At no time of the year was it possible to visit a cane estate and not find Froghoppers in nymphal and adult stages. During the dry season they are not numerous and generally congregate in damp cool spots near large drains or near rivers. Abandoned lands overgrown with grass and sickly canes with trash sticking to them afford ample protection during the dry months. As soon as the rainy season sets in the numbers gradually increase and from July to September they are most numerous. Excessive moisture does not seem to agree well with them. A table of seasonal history records is attached.

Relations of Froghoppers to Blight.

It was observed that canes attacked by root disease as well as those entirely free from it were "blighted." In every case there were Froghoppers present. With a view of throwing some light on the relationship of Froghoppers and Blight, a certain number of cane stools were enclosed in fine wire netting cages and kept perfectly free of Froghoppers. The fields selected were those likely to be blighted. Both cages yielded negative results. No blight appearing in the fields selected. In one case there were some Froghoppers present on the canes outside the cage.

Natural enemies.

No natural enemies of any consequence have been observed. In the cane fields there are several species of spiders that prey on the adults but the numbers that are destroyed are not many. The toads eat adults when on the ground, but owing to their size and colour the insects are well protected. Dr. Sharp mentions in the Cambridge Natural History (without giving the locality) that certain Hymenoptera pick out the nymphs from the spits and carry them off to be used as stores of provision for their larvæ. So far I have not observed any insect preying on the nymphs and their spittle appears to be an admirable protective device.

At times a good proportion of dead adult Froghoppers are found covered with a white fungoid growth that gradually turns green but there is some doubt as to whether it is a parasitic fungus.

Methods of Control.

Owing to the adult Froghoppers love of concealment during the day, the application of a contact insecticide is not practicable. The only way of dealing with the adults has been found to be by means of light traps at night. This traps consists of an ordinary hurricane lantern placed on a brick in a common baking pan filled with oil and water. Lantern and pan are placed on a small mound of earth about a foot high. As many lanterns as possible should be used and they should be placed in the cane beds at intervals of 50 feet. Fields should be treated systematically and the rows of lanterns advanced from 50 to 100 yards every night. Recently emerged insects and females about to lay are caught in this manner. As many as 28,875 were caught in one night with 13 lanterns. Males predominate over females to the extent of $\frac{2}{3}$ more or less. The nymphs can best be killed by a contact insecticide but there is one essential precaution to be taken to do this with any measure of success. The fields should be weeded as clean as possible and the canes trashed if necessary and trash and weeds removed from the field entirely. It is almost useless to attempt to spray a field overgrown with grass and with trash lying about as these afford too much protection to the insects. For thorough work knapsack sprayers would appear best. It is necessary to stop at each cane stool and drench it thoroughly, besides going over the ground between the cane rows. As many nymphs find their way through cracks into the soil below the surface spraying should be repeated at a three-week interval. The following mixtures yielded good results and did not damage the canes :—

Kerosene emulsion diluted	...	1–10.
Kerosene lysol emulsion	...	6 per cent.
Cyanide of potassium	...	1 oz. to the gallon

The best time to spray and to use any remedial measures against Froghoppers is immediately after crop and before the rains set in. Fields of plant canes should be specially watched as Froghoppers establish themselves on the grass before the canes are capable of supporting them. The cane traces and all abandoned fields should be burnt as they all serve as breeding grounds. By means of lanterns an attack can be localized. According to the number of adults caught the field can be treated either by clean weeding or by weeding and spraying the latter being better. A field yielding many adults is sure to contain a large number of nymphs.—Another way of treating nymphs which has been originated and adopted by Mr. J. Black is by ramming them into the earth when weeding operations are being carried out. As stated above "Boucans" in affected fields should be avoided especially in low lying lands. In some districts weeding and the use of unslacked lime applied to the cane stools yielded good results. Return of adult Froghoppers caught with trap lanterns and Formulæ of Insecticides used are attached.

Summary of proposed remedies.

1. Keep fields and traces as free from grass as possible.
2. Avoid "Boucans" in fields affected or likely to be so.
3. Do all spraying early in the year.
4. Use trap lanterns to locate insects and follow up by weeding fields and spraying cane stools.

F. W. Urich.

21st January, 1910.

Seasonal History Records of Froghoppers on Cane Estates.

Date.		Locality.	Records.
1909.			
February	18	Caroni ...	Few adults present. Nymphs in cane fields under clods of earth on rootlets of grass.
March	2	,, ...	Adults on cane leaves and on grass in traces. Nymphs on rootlets of grass and canes.
	10	Naparima ...	Adults and nymphs on savannah grass on small patch of canes growing in low lying ground, none found on rest of estate.
,,	11	Chaguanas ...	Adults and nymphs on canes not numerous. More so on an abandoned field on canes and grass.
May	26	Caroni ...	Adults and nymphs on canes and grass more numerous than on last visit.
June	7	,, ...	Do. do.
,,	16	Couva ...	Adults and nymphs on canes and grass on one or two fields only.
,,	22	Chaguanas ...	Adults present but nymphs more numerous. Canes showing signs of "blight."
July	2	Caroni ...	Do. do.
,,	7–12	Chaguanas ...	More numerous in nymphal stage.
,	19	Caroni ...	Adults and nymphs fairly numerous on canes and grass.
July	23	Chaguanas ...	Numerous in all stages in the whole district.
August	8	Princes Town ...	Adults and nymphs numerous on a small patch of para grass also on adjoining canes.
,,	10	Couva ...	Adults and nymphs present but not in large numbers.
,,	18	Caroni ...	Adults more numerous than nymphs.
,,	19–26	Chaguanas ...	Do. do.
,,	31	,, ...	Adults and nymphs numerous.
September	7	,, ...	Do. do.
,,	22	Caroni ...	Adults and nymphs present in fairly large numbers Some fields slightly blighted.
October	13	Tacarigua ...	Adults and nymphs numerous on canes and grass. Canes blighted.
November	15	Chaguanas ...	Adults and nymphs less numerous.
,,	15	Caroni ...	Do. do.
1910.			
January	4	,, ...	Few adults. Nymphs of all ages present. Small ones on grass roots. Advanced ones on cane roots.
,,	13	Chaguanas ...	Adults fairly numerous on canes and grass. Nymphs of all stages on grass and canes. Females contained eggs.

Return of Adult Froghoppers caught with trap lanterns.

Month.		No. of Lanterns.	No. of Insects.	Locality.	Remarks.
July	24–26	1, 1,000 candle power Kitson lamp.	163	Chaguanas ...	In all cases the canes improved after the use of the lanterns. The lights attracted many toads, which sometimes got into the tins to eat up the froghoppers.
,,	27–31	1 Hurricane lant'rn	241	,, ...	
Aug.	1–31	Kitson lamp ...	7,447	,, ...	
,,	1–31	3 Hurricane lanterns.	3,929	,, ...	
Sep.	1–16	12 Hurricane lanterns.	177,185	,, ...	
,,	17–30	48 Hurricane lanterns.	252,559	,, ...	
Oct.	1–6	48 Hurricane lanterns.	57,724	,, ...	
Sept.	20–30	12 Hurricane lanterns.	35,745	Claxton's Bay.	
Oct.	1–23	18 ,, ...	32,213	,, ...	
Sept.	24–30	13 ,, ...	22,060	Caroni ...	
Oct.	1–7	13 ,, ...	53,565	,, ...	28,875 were caught on the 6th October.

Formulæ of Insecticides used.

Kerosene Emulsion.

Kerosene	2 gallons.
Water	1 gallon.
Hard Soap	½ pound.

Shave the soap fine and dissolve in boiling water; while water is hot add kerosene; churn with a pump or garden syringe by pumping back into pail through a fine nozzle until a thick white cream is formed, this will take about 10 minutes. Use rain water when possible. For use dilute 1 gallon of above mixture in 10 gallons of water.

Kerosene Lysol Emulsion.

Kerosene	6 volumes.
Lysol	2 ,,
Water	100 ,,

The kerosene and lysol are mixed first and this mixture is then added slowly to 100 volumes of water with constant stirring.

Bibliography of Cane Blight and Froghoppers.

1863—Dr. Herman Crüger, Cane disease and Pests.—MS. discovered among papers at the Royal Botanic Gardens and published in the *Agricultural Record* (Trinidad), October 1892 p. 78.

1879—Ernest E. A. Francis, F.C.S., F.I.C., "on a Chemical Examination of Blighted Sugar Cane, and of the Soil in which they were grown."—Proceedings of the Scientific Association of Trinidad. Republished in the *Agricultural Record* of Trinidad, October 1892, p. 96.

Bibliography of Cane Blight and Froghoppers.—*Contd.*

1889—J. H. Hart, F.L.S.—Report on Sugar Cane Blight.—*Agricultural Record* of Trinidad, Vol. II., p. 126. Republished in *Bulletin* of Miscellaneous Information R.B.G., Trinidad, October, 1906, p. 152.

1906—F. W. Urich.—Froghoppers—*Mirror* Newspaper of September 19th, 1906.

1906—A new Sugar Cane Pest. —*Agricultural News*, No. 117, 1906.

1906—A. E. Collens.—Report on diseased Canes at *Harmony Hall* and *Tarouba* estates. Republished in Proceedings Agricultural Society of Trinidad and Tobago, Vol. IX, pp. 117-121.

1906—A. E. Collens.—Result of an inspection of Cane Blight disease at *Brechin Castle* estate.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, pp. 121-124.

1908—T. H. P. Heriot.—Contributions towards the study of the Froghopper, with 4 figures.—Proceedings Agricultural Society of Trinidad and Tobago, Vol. VIII, p. 549.

,, J. J. McLeod.—Paper on the Froghopper.—Proceedings Agricultural Society of Trinidad and Tobago, Vol. VIII, p. 552.

,, THE FOLLOWING LETTERS AND PAPERS ON SUGAR CANE BLIGHT AND FROGHOPPER—In Proceedings, Agricultural Society ofTrinidad and Tobago.

Hon. G. T. Fenwick, C.M.G.—Vol. VIII, page 557.			
H. Caracciolo, F.E.S., C.M.Z.S.	,,	,,	558.
A. E. Collens, F.C.S.	,,	,,	561.
Jas. Black	,,	,,	565.
J. W. Arbuckle	,,	,,	566.
Jas. Gaul	,,	,,	568.
Jas. Gilbert	,,	,,	570.

1909—Prof. P. Carmody, F.I.C., F.C.S.—Sugar Cane Blight and Analyses of Soils.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 107.

,, A. Urich, Ph. D., F.I.C.—Analysis of a heavy clay soil at Frederick (*Caroni* estate) badly attacked by Blight in July 1908.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 114.

,, F. W. Urich.—Froghoppers.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 125.

The Bud-rot of the Coconut Palm.

A disease of coconut palms now generally known as bud-rot from the fact that its culmination is the complete rotting of the terminal bud has killed during the last fifty or sixty years large numbers of trees in the West Indies and adjacent Central and South American countries. Though the disease was first reported in the early part of the last century it attracted no great attention until the early eighties when it caused serious losses in some of the large plantations of Cuba. Since that time bud-rot has been found on nearly all of the islands and has been studied by the pathological workers connected with the various Colonial Departments of Agriculture and by several members of the United States Department as well. A disease with the same characters has been found in a number of places in the East and described in the agricultural journals of India, Ceylon and the Philippines.

Bud-rot is characterized by the yellowing and drooping of the leaves, the falling of the immature nuts, the wilting, breaking over, and browning of the terminal leaf, and the putrid condition of the whole region of the cabbage. The disease may kill a tree very quickly if the point of first attack is near the bud itself, but when the older outer leaves are the first parts attacked the tree may live for some time before it finally succumbs. Though various theories have been put forward from time to time as to the cause of bud-rot it is now generally admitted that it is of bacterial origin, and that the putrid parts of dead and dying trees serve as a source of infection of healthy trees.

As reported to the Board of Agriculture at the November meeting the writer has found bud-rot, similar in all respects to that which has almost destroyed the coconut industry of Cuba, in various places here in Trinidad. Though spraying with Bordeaux mixture and Paris green or arsenate of lead may serve as a protection to young cultivations from infection with bud rot, thorough sanitation is the best means of combatting the disease in older plantations. In this sanitation the essential point is to destroy as quickly as possible all infectious material such as the rotted bud, the bases of leaves and flower stalks, the flower sheaths, and the upper portion of the stem, all of which are teeming with bacteria. This may be done by burning in the dry season but in rainy weather burying should be resorted to.

Many coconut planters believe that flaming the crowns of diseased trees will free them of the disease, and this method of treatment is practiced extensively in some places. In cases where the basal part of the outer leaves alone are attacked and the infection has not become deep seated, it is quite possible that the invading bacteria may be killed by the heat from the flaming, but it does not seem possible that trees in which the disease has reached the terminal bud or the young surrounding leaves can be saved by this method of treatment. Flaming

has been practised during the past year on Mr. Gordon's Laventille estate, so that some idea of the value of this method of treatment may be gained there within the next few years.

As the coconut bud-rot has gained a foothold here in Trinidad, every means should be taken to combat it before it becomes too widespread. The Board of Agriculture has already voted the sum of $500 for this purpose, and the work of cutting down and destroying diseased trees has been begun and is being pushed forward as rapidly as is possible. The work was started in the Laventille district on November 30, and to date (January 8), 1,151 dead or dying trees have been cut down. The trees which had evidently been dead for a long time and which were hard and dry have been cut into junks and piled for burning, while all which were at all green or in which there was any evidence of soft rot were buried wholly or in part. The writer hopes that all diseased trees on the island may be destroyed in this way within the next six months.

Mr. Plummer, Agricultural Inspector, has been given immediate charge of this sanitation work, and he has pushed it forward very rapidly and tactfully as well.

To make this work of any lasting value however it is essential that a Coconut Palm Protection Ordinance be passed which will make it possible to force property owners to destroy coconut trees which subsequently become diseased. An inspector could then be appointed whose duty would be to see that the Ordinance was rigidly enforced.

The following paper entitled "The Serious Coconut Palm Diseases of Trinidad" by J. R. Johnston, Assistant Pathologist, U.S. Department of Agriculture will undoubtedly prove of interest to the coconut growers of the Island, by some of whom at least the author is known personally. Mr. Johnston has devoted almost his entire attention during the past four years to the study of coconut diseases, especially the bud-rot. Though most of his work has been done in Cuba he has carefully studied the diseases of the coconut in Jamaica, Trinidad, and Demerara so that his experience has been wide. The present paper of Mr. Johnston is a criticism of the various reports on coconut diseases in Trinidad which have been published during the past few years.

As will be seen his studies have led him to different conclusions from those of some of the other workers on these diseases. He considers that the death of palm trees resulting from the soft rotting of the cabbage must, in practically all cases, be attributed to bud-rot, a disease primarily caused by bacteria, rather than to the attacks of one or more fungi which accompany the rot or are found on the leaves or roots of dying trees, while the others have considered bud-rot a minor disease here, restricted to a few localities, and the soft bacterial rot of the cabbage, in the majority of cases, simply a secondary symptom of diseases caused by fungi.

Inoculation experiments with fungi or bacteria suspected of being parasitic are essential in establishing the cause of both plant and animal diseases. From a lack of such experiments much confusion has arisen in regard to the various diseases of the coconut palm, as can be readily seen from a reading of the literature on the subject. The writer knows that Mr. Johnston has produced bud-rot by artificial inoculation. It is to be hoped that the complete report of his work will soon be published, and will clear up some of the doubtful points in regard to this and other coconut diseases.

James Birch Rorer,
Mycologist.

The serious Coconut Palm Diseases in Trinidad.

Within recent years at least five different investigators have studied the diseases of the coconut palm on the Island of Trinidad and they have arrived at different conclusions. Unfortunately none of these workers carried on their investigations to the length of establishing all the facts necessary to substantiate their theories as to the cause of the trouble. In view of these incomplete researches and the diverse conceptions of the maladies it is impracticable to give satisfactory recommendations as to methods of control or eradication. It is very possible, however, that by carefully comparing the observations of the various investigators some more uniform conclusions can be reached. The writer studied the conditions in the coconut groves of Trinidad after acquiring a good knowledge of the groves of Jamaica and Cuba. Before this work the reports of J. H. Hart* and F. A. Stockdale† on the diseased palm were carefully perused, and, since then, the reports of O. W. Barrett‡ and of Dr. Fredholm§ upon the same topic. As the point of view of these various workers has been different from that of the writer, and especially as their interpretation of certain phenomena connected with the disease is at variance with his, it is desirable to call attention to these points. In discussing the condition of the trees, only the one or more diseases that cause their death will be considered.

The earliest investigator, Mr. Hart, reported, in 1905, that on "La Retraite" estate, Cedros, diseased trees were found to be infected from the ground upward, the stem showing a ring of red discoloration lying between the woody exterior and the cellular interior. The discoloration became more prominent toward the growing point and appeared especially at the base of the leaf-stalks, and at the base of the embryonic spathes enclosing the floral organs. These all eventually became quite putrid, the leaves fell, and the tree gradually died. Great quantities of bacteria as well as fungi were found in the affected tissues. Mr. Hart did not commit himself as to the cause of the trouble, but forwarded some of the material to the Imperial Department at Barbados, whence it was sent to the Department of Agriculture at Washington. Here I had the opportunity of examining it, and am able to corroborate Mr. Hart's statement that the growing point was full of bacteria. In the particular specimens which I have now mounted as microtome sections on glass slides, bacteria only are among the cells, there being no signs whatever of fungi.

Mr. F. A. Stockdale investigated the diseased coconut palms in the fall of 1906. He reported on two maladies which completely

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* Bull. Miscellaneous Inf., Bot. Dept. Trinidad, Oct. 1905, p. 241.

† Trinidad *Royal Gazette*, Feb. 14, 1907, pp. 349 to 363.

‡ Rept. to the Agric. Soc. of Trinidad and Tobago, Soc. Paper No. 280.

§ Dr. A. Fredholm, Proc. Agric. Soc. Trinidad and Tobago, Vol. 9, March, 1909, Pt. 3, pp. 159 to 172. Soc. Paper No. 367.

destroy the palms; one of which he called the root-disease, and the other the bud-rot. He described the root-disease as one in which the trunk shows the red discoloration toward the outside for considerable of its length, and the decayed roots and the petioles are infected with a fungus. Eventually, when the vitality of the tree has been reduced, the terminal bud becomes involved in a soft rot and the putrid mass then falls over and the tree dies. In describing the bud-rot Stockdale says the roots appeared to be healthy, the stems showed no signs of the discoloration but the bud was involved in a vile sort of bacterial rot and eventually fell over. In the advancing margin of the rot usually were only bacteria, but in a few cases there was some fungous mycelium. Mr. Stockdale concluded that the root-disease was due to fungi and the bud-rot to bacteria. According to his descriptions trees suffering from the root-disease differ from those affected by the bud-rot only in having discolored trunks, diseased roots, and affected petioles, the rotting bud being common to both cases.

Mr. O. W. Barrett in 1907 reported that of the diseased trees of the island, about ninety-five per cent. were affected with the root-disease reported by Mr. Stockdale and only a very few cases were affected by bud-rot. Unfortunately no notes are given as to the appearance of the diseased trees, so that Mr. Barrett's conception of these maladies is uncertain.

Dr. A. Fredholm presented before the Agricultural Society an article published in March of the present year. He described a serious disease in which the trunk was normal and the roots usually so, while the terminal bud became disintegrated into a sour smelling, whitish, semi-fluid mass which, when examined under the microscope, was seen to be swarming with bacteria. The adjacent tissues, out to the petiole bases, were traversed by fungous mycelia, which Dr. Fredholm believed to be the forerunner of the bacterial rot. He states that he considers Stockdale's root-disease and the foregoing disease distinct, chiefly for the reason that he has never found the decay of the roots and the discolored stems present in the affected trees which he examined. He further states that he found a few cases of what was supposedly bud-rot, *i.e.*, putrid terminal bud full of bacteria and entirely lacking in fungi. To substantiate his statements Dr. Fredholm obtained successful fungous infections (small spots), but he made no bacterial inoculations.

My own observations in Trinidad confirm the ideas of the foregoing writers in regard to the general symptoms of the trouble affecting the coconut palms of that island; the drooping and yellowing leaves, the premature falling of the nuts, the putrid condition of the bud, and the occasional occurrence of fungi on the bases of the petioles, the diseased condition of the roots, and a red discoloration of the trunks.

As regards the cause of these troubles of the palms, Hart states merely that both fungi and bacteria are present in the advancing margin of the rotting tissues of the crown. He does not commit

himself as to the cause of the disease. Stockdale believed the root-disease to be due to fungi and the bud-rot to bacteria. He came to these conclusions after discovering, in cases of the root-disease, some mycelium in the decaying roots, in the discolored trunks, and in the bases of the petioles. The rotting bud full of bacteria he considered secondary when these other symptoms were present. In the case of the bud-rot he found this putrid mass at the crown to be filled with bacteria, and only rarely to contain some fungous filaments, while the conditions typical of the root-disease were absent; he, therefore, concluded the bud-rot was probably due to bacteria as has been claimed by workers in Cuba and elsewhere.

Fredholm believed that those trees in which the bud had become disintegrated into a putrid mass, swarming with bacteria and surrounded by tissues traversed by fungous mycelia, were primarily affected by the fungi which prepared the way for the bacterial soft-rot action. He found some trees with this soft rot but in which no fungous mycelium was to be seen and for that reason admitted the probable ability of the bacteria to produce primary infection.

The conclusions of Stockdale and Fredholm appear entirely unwarranted from the observations which they have reported. Because fungous mycelium is found in the decaying tissues of a plant is not sufficient reason for stating those fungi to be the cause of the decay. Stockdale describes the soft rot of the crown which eventually occurs in the root-disease, and states that it is a different sort of rot from that in the bud-rot disease. He claims that lowered vitality or mechanical injury may produce such a rot, without, however, citing any experiments to prove this. It is, however, contrary to my own experience. I have wounded many trees through the heart tissues, have seen many trees eaten in the crown by insects, and others suffering extremely from some evil condition of the soil, but in none of these I have in mind has the soft rot developed. It might possibly develop along with an unhealthy condition of the growing point but I do not believe it is a natural sequence, such as Stockdale indicates. His description of the soft rot in the root-disease corresponds exactly to that of the bud-rot, and should be considered a symptom of the latter trouble. Whether the soft rot may be due to various causes, is a different matter. Whether there are various accompanying conditions is another question. The fact remains that in Stockdale's root-disease and in the well-known bud-rot there is a soft-rotted condition of the bud which causes the death of the tree. This must be essentially one and the same disease. In cases of the bud-rot in Cuba, Jamaica, Trinidad, and British Guiana, I also have found fungous mycelium at the base of the petioles and in the roots, but always, I believe, as a secondary phenomenon, and no more than was to be expected. If the tree is lowered in its vitality for any reason it becomes an easy prey to infection by various saprophytic organisms.

The same sort of criticism applies to Fredholm's treatment of his fungous disease. As he describes it, the bud is resolved into a soft-rotted mass, swarming with bacteria, and the surrounding tissues

are traversed by fungous mycelia. Fredholm considers the fungi as forerunners of the soft-rotted condition. He may be correct but he presents no proof that such is the case. The soft rot in the crown can apply only to the one disease, *i.e.*, the bud-rot. As to whether or not fungi are the forerunners of this disease is an entirely different question. We must get clearly in mind the idea that the term bud-rot applies to any case in which the bud of the tree is reduced to a soft-rotted mass which is swarming with bacteria. It is the decay of this bud which causes the death of the tree. Fungous mycelium in the petiole or in some of the hundreds of roots of the tree will not soft rot the terminal bud. In few of these cases described by Stockdale and Fredholm was the mycelium very abundant, but, on the contrary, was usually scarce and occasionally difficult to find.

These investigators found in all cases of seriously diseased trees a putrid condition of the crown in which were abundant bacteria and, in addition, they found on some trees fungous mycelium on the roots, on the trunk, or in the bases of the petioles. In the diseased trees in which any fungous mycelium was found to be present, both Stockdale and Fredholm attributed the trouble to the fungus, notwithstanding the presence of bacteria in the soft-rotted crown; on the other hand, the trouble was admitted to be due to the bacteria only when no other organism was found in the diseased parts of the tree.

After comparing the various reports referred to in this article, it would seem quite clear that the only destructive disease of the coconut palm in Trinidad has the one characteristic of the rot of the growing point or bud of the tree, and from the foregoing discussion of the descriptions it is evident that it is the well-known bud-rot common to various parts of Tropical America and to the Eastern Tropics.

It has not yet been proved what organism is the cause of the bud-rot, although generally admitted to be due to bacteria. The identification of diseases passing under different names as all one form, will, however, do much to facilitate the solution of the cause of the trouble. To know that Stockdale's root-disease and Fredholm's fungous disease and the bud-rot are all phases of the same malady, will, I am sure, greatly simplify the work. The frequently accompanying fungi may well give rise to the question as to whether or not general unhealthy conditions of the tree may furnish opportunities for bacterial infection. Such conditions may be caused not only by the presence of fungi, but also by unsuitable soil, or by unfavourable climatic conditions. As these factors are subject to partial control, herein lies an opportunity of treating trees affected with bud-rot, provided the disease is induced by these conditions. On the other hand, if the fungi are secondary and if the unsuitable surrounding conditions are not necessary to the successful production of the bud-rot, the infection with bacteria can then be considered as the primary symptom and treatment can be made with that in mind. If the rot is bacterial the disease can be controlled

only by destroying most of the distributing organisms. Thus a thorough knowledge of the cause of the death of the tree, together with various accompanying conditions will enable the investigators to limit their plans to but one line of the work instead of making elaborate preparations for the control of the various conditions which are found to be but phases of the one disease.

It is urged that conclusions as to the cause of the disease should be proved by infection experiments. Stockdale made no experiments which brought about the death of the tree from fungous inoculation. Fredholm secured some successful fungous inoculations but they did not cause the death of the tree. I have obtained good fungous inoculations on the leaves and in these cases the spread of the disease was shown in the drying and browning of the tissues, but never to the extent of killing the tree. In addition I have made bacterial inoculations which produced soft, white rots, such as are found in the typical bud-rot. In several cases where these bacterial inoculations were left for some months, the death of the trees eventually took place. The specific organism has not yet been successfully isolated, but as long as the artificial soft-rot can readily be secured from bacterial cultures, completion of the work is but a matter of time.

While differing with the conclusions of the other investigators, acknowledgment must be made of the value of their observations. A thorough understanding of the accompanying conditions is necessary to the successful development of a method of control of any disease. It is seldom sufficient that such a work be conducted alone from the point of view of a botanist or mycologist, but the observations of an entomologist and a bacteriologist are also desirable.

JOHN R. JOHNSTON,
Assistant Pathologist,
U. S. Department of Agriculture.

Cacao Canker.

Some years ago I devoted more than a year in Ceylon to the investigation of Cacao Canker and its prevention and cure and for six or seven years carried on this work, with my other official work. I have visited nearly every cacao estate in Ceylon, many of them on several occasions, and it may be of interest to cacao growers in Trinidad to know that their cacao of which I have seen a good deal already is compared with Ceylon extremely free from disease.

The explanation of this I am puzzled to find—the conditions of cultivation in Trinidad are specially fitted to encourage the spread of parasitic fungi. It is true that prophylactic work is carried out on many estates, but not with sufficient constancy or energy to entirely explain the comparatively small amount of canker. Estates have been practically freed from canker in Ceylon, but only by employing large gangs of labourers continuously day after day throughout the year doing nothing else but surgical work on the cacao tree.

Madame A. E. Van Hall, the wife of the Director of Agriculture, Surinam, has for some time been working at the parasitic fungi which attack cacao trees, and from her pen we have had recently a neatly written outline of the investigations which have been carried on by Messrs. Petch, Stockdale and myself and an interesting account of her own research. My own work which was carried on some twelve years ago is considered at some length, and the following is the summary of the conclusions came to by Madame Van Hall. The paper discusses points of much interest to plant pathologists and mycologists, though the subject is perhaps too academic to be of much practical interest to the planter.

I am not satisfied that the naming of the fungus causing the cacao canker *Spicaria colorans*, without an extra knowledge of the life history of the fungus, is an advance. The fact that I was unable working on a cacao estate in Ceylon to use the pure cultures for my infection-experiments certainly reduces the value of the results, but the number of the trees infected and the constant association of the perithecia of a *Nectria* type with the mycelium and with the other spores of the fungus causing the canker seem to me to afford evidence which cannot be neglected. Moreover, the authoress of this paper has herself not succeeded in any infection experiments with the "fungus imperfectus" which she proposes as the plant causing cacao canker.

Madame Van Hall gives some excellent figures of the fungus *Spicaria colorans* which agree very closely with many drawings in my note books of twelve years ago, the coloured drawing of the effect of the parasite on the cacao tree gives an excellent representation of this characteristic disease. The following is her summary of the paper:—

"1. The 'canker' or 'redrot disease' which has been known in Surinam for a long time and in 1907 did so much damage in the Saramacca-district, is caused by a species of *Spicaria* which we have named *Spicaria colorans* n. sp.'

"2. Besides the *Spicaria fructification*, *Spicaria colorans* also forms a Fusarium-fructification. A higher fructification, especially perithecia, never

appeared in the cultures; neither have perithecia belonging to *Spicaria colorans* ever been found in nature."

"3. A species of *Nectria*, which has often been found on diseased cacao trees, proved to be a fungus quite different from the parasite and having nothing to do with the disease; it must be considered as a harmless saprophyte. This *Nectria* bears a strong resemblance to *Nectria striatospora* Zimm., described by Zimmerman."

"4. The canker-disease occurring in Surinam is in all respects so much like the stem and branch-disease of the same name in Ceylon, in Java, in the Antilles and in the Cameroons, that we have doubtless to deal with the same disease in all these countries."

"5. A species of *Nectria* is universally held to be the parasite. In Ceylon Carruthers found a *Nectria* which he considered the cause of the disease; this conclusion however is not warranted, the parasite having evidently not been isolated in pure cultures and the *Nectria-perithecia* having not been observed in such cultures. The infection-experiments teach us nothing about the true character of this *Nictria* as pure cultures were not used. Moreover one is inclined to believe this *Nectria* harmless from the fact that it has only been found on dead parts of plants and not only of cacao trees but also on dead tea shrubs, felled Albizzia and other dead wood. Petch calls it the commonest Ceylon *Nectria*."

"The question of its identity has not yet been settled (a good description and pictures have not yet been given). Carruthers named it *N. ditissima* Tul., Petch believes it to bear a strong resemblance to *N. striatospora* Zimm., and the examples collected by Thwaites in the herbarium have been named by Berkeley either *N. cinnabarina* or *N. sanguinea*."

"Howard believed two *Nectria's* to be the cause of the canker-disease in the Antilles; Massee named these species *Nectria Theobromæ* and *Calonectria flavida*. Their parasitic character is however not yet certain and the life history of these fungi has not yet been elucidated."

"In the Cameroons von Faber found a species of *Nectria* on cacao which, to judge from his figures and descriptions, is different from *N. Theobromæ* and from the *Nectria* observed as a saprophyte in Surinam. As he could only study fixed material and could not cultivate the fungus or make infection-experiments, he merely supposes that it might be the cause of the canker-disease."

"*From the foregoing it is evident that nowhere a Nectria has been definitely proved to be the cause of the canker-disease, while several observations make it very likely that all these species of Nectria are but harmless saprophytes.*"

"6. In Ceylon the canker is believed to attack not only the stem and branches but also the pods of the cacao tree. On diseased pods on which *Phytophthora* also occurred, Carruthers found small spores, which he calls cankerconidia."

"He however failed to prove, that the same fungus, which caused the canker of the stem and branches had, also affected the pods, and very likely in this case too a saprophyte was wrongly regarded as the cause of this pod-disease, which was probably nothing but 'black rot' of the pods caused by *Phytophthora*."

"*Up till now we have no data, which prove or even make it* likely that the canker-disease may attack the pods."

The whole question of the relative responsibility of *Nectria, Phytophthora, Diplodia* and other parasitic fungi in cacao canker is reopened by a note which Mr. J. B. Rorer contributes to this Bulletin. His research is undoubtedly a most important contribution to the cacao disease investigation and it seems likely that his culture and inoculation results will shift the blame of the claret-coloured patches which some of us attribute to *Nectria*, some to *Calonectria*, and some to *Spicaria*, to *Phytophthora omnivora* which will thus still further justify its name.

In a later issue of this Bulletin Mr. Rorer will give a more exhaustive and conclusive account of his researches to which all interested in cacao canker will look forward with much interest.

J. B. C.

The Witch Broom Disease of Cacao in Surinam.*

INTRODUCTION.

AMONG the diseases of tropical plants which have attracted the attention of pathologists within the past few years, the witch broom disease of cacao in Dutch Guiana is perhaps the most important, not only on account of the great financial loss which it has brought to the growers of Surinam, but because of its scientific interest as well.

Though the disease must have existed in Dutch Guiana for a long time, its serious nature was not recognised until 1895, in which year the growers in the Saramacca district spread abroad alarming news of its devastations. In this district it reached its greatest intensity in 1900; since that time the losses have abated to a certain extent. In the plantations further inland, along the Commenwijne and Surinam rivers, the seriousness of the disease was recognised a few years later than in Saramacca, and in these districts it reached its greatest intensity in 1904.

The following table, showing the annual exports of cacao from Dutch Guiana from 1899 to 1906 will give an idea of the damage caused by the disease :

1899	...	...	8,492,000	lbs
1900	...	...	6,439,400	,,
1901	...	...	6,959,700	,,
1902	...	...	5,181,440	,,
1903	...	...	4,942,740	,,
1904	...	...	1,878,800	,,
1905	...	...	3,699,960	,,
1906	...	...	3,257,320	,,

In 1906 the disease was found by Bartlett in a plantation on the Demerara River, and since then it has been discovered on other estates in British Guiana. Up to the present time, it has not been observed in other cacao growing countries.

BIBLIOGRAPHY.

For some time the planters of Surinam ascribed the disease to a great variety of causes, mostly physiological, such as poor soil, too much shade, or lack of drainage. Some believed that the curious growths, the so called witch brooms, were mere epiphytes, and not

* NOTE.—Early last year the Director of Agriculture obtained permission from van Hall and Drost to reproduce in the Bulletin of Agricultural Information the plates illustrating their paper on the Witch-Broom disease of cocoa in Surinam. Soon after assuming the duties of Mycologist the writer was asked to prepare a short paper on the disease to accompany the plates. This was done, but owing to the delay in the publication of the Bulletin it appears now at rather a late date as a full translation of van Hall's paper together with the plates has recently been issued in the Proceedings of the Agricultural Society. It has been thought unnecessary to publish the plates again.

part of the cacao tree at all. The first papers of scientific interest dealing with the disease, are those of Ritzema Bos [a], in 1900 and 1901, in which he ascribed the disease to a new species of fungus, which he called *Exoascus theobromæ.* Unfortunately, this author's work was all done in Holland, with very poorly preserved material sent from Surinam, and is not at all convincing. Although subsequent investigators have found fungous threads in the diseased tissues, no fruiting bodies of the Exoascus type have been observed.

In 1901 Hart [b] sent material to Kew and to the Imperial Department of Agriculture at Barbados. That sent to Kew was examined by Massee, but the results were negative as far as the identity of the fungus was concerned, as no fruiting bodies were present. Howard [c] examined the material which was sent to Barbados. He found no Exoascus, but a species of Fusarium fruiting on the bark, which he stated might have some connection with the disease.

Went [d] was the first pathologist to devote any great amount of time to the study of the disease. He spent six months in Surinam in 1901, and came to the conclusion that the disease was of fungous origin, and was one not only of twigs and branches, but of the pods as well. The latter, through the invasion of the fungus, became more or less distorted and finally hard and woody. Went was unable, however, to find any fruiting bodies of the fungus, so that he could not identify it.

Charles [e], from a study of dried material suggested that a species of Lasiodiplodia might be the cause of the disease.

In 1905, Dr. C. J. J. Van Hall, [f and g], the well-known Dutch pathologist, with the assistance of A. W. Drost, of the Agricultural Experiment Station, Paramaribo, began a study of the disease. Preliminary reports of their work were made late in 1905 and 1906, and a full report was published in 1907. The authors were unable to find any fungus of the Exoascus type, as described by Ritzema Bos, but confirm Went's supposition that the disease of the pods is caused by the same fungus as that which causes the witch brooms on the branches. Still further, they found that the fungus attacked the cushions, causing abnormal production of flowers, and finally they discovered the fruiting bodies of the fungus and described it as a new species of Colletotrichum, *C. luxificum.* They describe the different forms of the disease at length, and give the characteristics of the

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(*a.*) Ritzoma Bos.—Tijdschrift over Plantenziekten, 6 : 65—1900.
Zeitschrift Pflanzenkrankheiten, 11 : 26-30—1901.

(*b.*) J. H. Hart.—Trinidad Bot. Dept., Bull. Misc. information, No. 27, p. 328—1901.

(*c.*) A. Howard.—West Indian Bulletin, 2 ; 205, 289—1901.

(*d.*) F. A. F. C. Went.—Verh. Konig Akad. v. Wetensch, 2 sect. 10: 3—1904.

(*e.*) V. K. Charles.—Jour. Myc., 12 : 145-146—1906.

(*f.*) C. J. J. van Hall.—Tropical Life, 1 : 12—1935.
2 : 83—1906.

(*g.*) C. J. J. van Hall and A. W. Drost.—Travaux Botaniques Néerlandals, vol. 4, pp. 77, 16 plates—1907.

fungus in detail; in fact, the whole paper is such an excellent piece of work that it is only to be regretted that the authors did not go a step farther and prove absolutely by a series of inoculation experiments with pure cultures, that their fungus is the cause of the typical witch-brooms, and that the "male" cocoa, star blooms, and indurated pods are all forms of the same disease [1].

The Possibility of Witch Broom in Trinidad.

During the past four months, the writer has visited a number of estates in various parts of the island, and in many places has found abnormal growths on cacao trees. The agricultural inspectors also, from time to time, have sent in for examination, specimens of such growths. On these various lots of material, the same fungus has usually been found, and microscopically it is very similar to Van Hall's *Colletotrichum luxificum*. It has also been obtained from diseased pods. Considering these facts, it has been thought advisable to issue this preliminary Bulletin in order to call the attention of the planters to the disease, and to give them descriptions of its various forms, so that they will be better able to recognise it if present on their trees, but it must be understood that it has not been proved that "male" cocoa, star blooms, indurated pods, etc., are connected with Witch-Broom, and that typical witch-brooms have not been found in Trinidad. The serious proportions which the disease has attained in Surinam, is due primarily to the fact that it went for so long a time unrecognised, and had become widespread and had caused great loss, before any remedial measures were tried. The writer is carrying out inoculation experiments with the species of Colletotrichum which has been isolated from diseased trees and pods, the results of which will be reported upon later [2].

Description of the Disease.

The following pages give a summary of Van Hall's and Drost's description of the disease as well as the remedial measures suggested by them, and the plates are reproduced here with their permission.

There are three distinct external characteristics of the disease, namely, the witch brooms; the hardened fruits; and the flowers in star-like clusters.

Witch Brooms.

A typical witch broom is a dense broom-like growth brought about by an excessive growth of lateral shoots, together with a shortening of the internodes of the affected twig. The main branch of a cacao witch broom is two or three times the thickness of a

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(1.) Although Dr. Fredholm's translation reads that "inoculations have demonstrated that this fungus is the actual cause of the disease," no account of such inoculations is given, nor is there any proof given that the fungus referred to is Colletotrichum luxificum. To the writer's knowledge witch-brooms have never been produced by inoculations with a pure culture of either a fungus or bacterium.

(2.) As yet no definite witch-brooms or other abnormal growths have resulted from these inoculations. In some cases the species of Colletotrichum used has proved to be a rather weak parasite causing young leaves to wither and dry up and the fungus mycelium has at times been found in the leaf petioles of inoculated plants. Inoculations with it are still being made.

normal branch, especially at its base, and the surface is generally rough or wavy. The leaves of such a branch never reach normal size; but always remain soft and limp, and are often of a darker colour. The stipules, which normally drop early from the leaf bases, are abnormally large and persistent. Before this branch has grown out very far, the axillary buds begin to develop into lateral branches, so that soon a more or less typical broom-like growth is formed. Very few leaves are formed on the lateral branches, but the stipules are very noticeable. These witch brooms develop very quickly, but their life is short too. Soon after they have reached their maximum development, they begin to die generally from the base upward, and eventually dry up. After a serious outbreak of the disease, the trees have quite a considerable number of these dead brooms, and these offer a point of entrance for other fungous or insect parasites. The witch brooms develop not only on the ends of branches, but may develop from the lateral buds and from either young or old wood. Those which grow from the cushions may be considered as transformed floral branches,—in fact they often bear flowers along the hypertrophied branches.

Indurated Pods.

The hardening of the fruit was not connected with the witch broom disease for some time, being considered simply the black rot caused by *Phytophthora omnivora.*

The typical characters which these affected fruits show are a hardening of the infected region; small protuberances which appear on young or half-grown fruits; the hypertrophy of the peduncle; and the black colour of the diseased area. Many affected pods fall off when quarter or half-grown, and some reach maturity; but the beans from such pods are not of good quality and are light in weight.

Starlike Clusters of Flowers.

When a cushion becomes infected, the disease is made manifest by a sort of floral witch broom or star shaped cluster of flowers, brought about by an abnormal development of lateral buds just as in the vegetative witch broom. A great number of flowers are in this case produced, and among these are often one or several vegetative branches, which in turn are transformed into small witch brooms. As a rule no fruits come from these flowers in stars, but at times they produce small misshapen pods with no seeds, the so called "male" cacao. At times however, these flowers produce a small number of fruits which reach maturity, but they generally show infection in one way or another. In other cases the infected cushions give rise to typical witch brooms which often bear flowers along the branches.

Cause of the Disease.

As mentioned above the authors state that the cause of the disease is a fungus, the mycelium of which is always found in the witch brooms, hardened pods, and diseased flower clusters. Hyphæ

or vegetative threads of this fungus are easily seen with the microscope, extending throughout the diseased branches, and running out into the leaves and flowers as well. In the affected fruits, the mycelium is present in and about the diseased areas; and in the star-like flower clusters, it can be found not only in the floral organs but running back through the peduncle, or flower stem, into the cushion. In the cushion, however, the mycelium seems to be short lived. By thoroughly sterilizing the surface of young pods, which showed the first evidences of the disease, and then keeping them in such a way as to be free from external contamination, the authors were able to obtain pure cultures of this fungus. Bits of branches from the young witch brooms were treated in the same way, and yielded the same fungus as the pods. On some of the cultures spore production took place, so that the fungus could be classified. It proved to be a new species belonging to the genus Colletotrichum, and the authors have given it the name *C. luxificum.* (The large group of diseases known as anthracnoses are caused by other species of Colletotrichum and of Gloeosporium, a closely related genus. The commonest examples here perhaps are the anthracnose of mangoes and alligator pears.)

The authors found that spore production took place naturally, both on the hardened pods and parts of the witch brooms, under certain weather conditions. The sporulation on the fruits takes place most commonly just at the beginning of the dry season. The spore masses are somewhat pinkish and frequently are arranged in a circle about the diseased area. The disease is doubtless spread from tree to tree by means of these spores. During the rainy season, spores of another type are produced and these also aid in the spread of the disease. The spores can only infect very soft and young tissue, and it is only those reaching and developing buds or young stems, which cause the infections. After infection has taken place, the mycelium of the fungus develops rapidly in the tissues, and causes the characteristic hypertrophies.

The Effects of the Disease on the Cacao Tree.

Not only is the crop greatly diminished through the contamination of the fruit, but a large number of the trees become worthless or die as a result of the infection. Trees which are badly attacked produce only witch brooms and no sound growth at all, and such trees give scarcely any cocoa. When the witch brooms die the trees are left practically without any foliage and soon become a prey for boring insects and semi-parasitic fungi. If the trees are left moderately attacked they may throw off the disease, so to speak, but cankerous regions are generally left at the points where the witch brooms were attached. These diseased areas may heal over in time, but often they remain as open wounds and serve as points of infection for Chætodiplodia.

The disease has also caused serious damage to nursery stock, or to young trees which have been set out as renews. In such cases the whole top of the tree may be converted into a witch broom, or the abnormal growth may occur farther down the stem.

Predisposition to the Disease.

All the varieties of cocoa which are grown in Suriname, Criollo Forastera, Calabacillo, and Nicaraguan Criollo seem to be equally susceptible to the disease. Nor do external conditions, with the exception of the rainfall, influence the outbreaks in any way. The disease is found on trees grown at all altitudes, on all kinds of soil, and on well drained as well as on poorly drained land. It is prevalent on estates with no shade and on those with moderate or dense shade.

The disease has always been more severe in those years in which the rainfall has been quite evenly distributed throughout the rainy season, than in those with abnormally heavy rains followed by some days of dry and sunny weather.

Witch Brooms on Other Trees.

In connection with the work on cacao, the authors found witch brooms on both species of immortelle, the mango and the mamee apple, but an examination showed that *Colletotrichum luxificum* was not the cause. Its parasitism seemed to be confined to the cacao tree alone.

Treatment of the Disease.

The methods of treatment which Dr. Van Hall recommends are very drastic, but are proving successful on those estates in Suriname on which they have been tried. The method is to cut off the whole crown of the tree by taking of all the main limbs two or three feet from the point of forking. The dehorned tree is then thoroughly sprayed with Bordeaux mixture. This work should be done towards the end of the dry season. Trees thus treated will form a new head in a few months. As the trees begin to grow again they should be inspected frequently and any witch brooms which are found should be cut off and burned, together with the cankerous area on the mother branch at the base of the broom. On plots of trees which were treated in this manner in 1905, careful records were kept of the yield in 1906 and 1907. Even in that short time the percentage of indurated fruits was very much reduced, and the total crop from the block of treated trees was more than twice from a similar block of untreated trees.

James Birch Rorer,
Mycologist.

August 6, 1909.

The Relation of Black-rot of Cacao Pods to the Canker of Cacao Trees.

THE facts that cacao pods arising from cankered cushions usually become black, and in the early stages of decay are well covered with the sporophores of *Phytophthora omnivora*, the black-rot fungus; that healthy cushions frequently become cankered when the pods which they bear are attacked by this fungus; and, finally, that the fungus can be isolated in pure culture from cankered inner bark some distance from a cushion, led the writer to believe that the two diseases were caused by the same fungus. A series of inoculation experiments made with *P. omnivora,* and a number of different fungi supposed to be parasitic on cacao trees and pods has been made and the results seem to show that the greater part of the canker, here in Trinidad at least, is caused by *Phytophthora,* and that the black-rotted pods are the chief source of infection of the tree.

This species of *Phytophthora*, which has long been known to cause the black-rot of pods, grows readily in various culture media and fruits exceedingly well on sterilized potato cylinders or bits of cocoa wood or pods. Pure cultures of the fungus can be obtained by the usual bacteriological methods.

For the inoculation experiments a block of trees isolated from other cocoa trees and quite free from both black-rot and canker was selected so that the danger from outside infection was reduced to a minimum. Pods one half to three quarters grown inoculated with *Phytophthora* spores from a pure culture began to rot within a few days and at the end of a fortnight were entirely black, and covered with the sporophores of the fungus. When such pods were cut from the tree it was found that not only the cushion but the surrounding bark as well was cankered and that the fungus could be isolated from such diseased tissues. Inoculations made with the same fungus in either old or young wood invariably produced cankered areas within a very short time. When inoculations were made on a limb one or two inches above or below a pod the canker produced on the limb spread to the pod which began to rot from the stem end outward and sporophores of the fungus were found on the surface.

Up to the present time about forty inoculations with this fungus have been made every one of which has produced disease while not one of the control punctures has caused a pod to rot or the bark to become cankered.

A bulletin describing both diseases in detail, the causative fungus, and other associated fungi is in course of preparation and will be issued as soon as the illustrative plates are received from England.

JAMES BIRCH RORER,
Mycologist.

10th March, 1910.

Flemingia Strobilifera, Br.

(A COVER PLANT).

THE question of establishing cover plants beneficial to the soil instead of allowing grass and other non-beneficial weeds to grow is of great importance to Agriculture in Trinidad, experiments and observations are being carried out, and I propose to discuss the matter in an early number of the Bulletin. What is wanting is a low growing preferably leguminous non-woody plant which grows vigorously and does not require much care or any replanting.

The following are analyses of a plant which grows very freely without tending and contains nitrogenous nodules. It is however rather too large and woody to be an ideal plant for cover purposes, but the ease with which it can be established is in its favour :—

J. B. C.

Two plants were taken for analysis, and after the earth had been washed off the roots, the sample was allowed to dry at room temperature for four days.

The roots contained a fair proportion of nodules, but these were of small size, barely larger than a pin's head.

The leaves and roots were removed from the plants and the different parts weighed.

Leaves ...	... 61·0g. =	20·9	per cent.
Stem and branches	... 165·3g. =	56·6	,,
Roots ...	... 65·9g. =	22·5	,,
	292·2g.	100·0	,,

The leaves contained...	... 12·36 °/$_o$	of water.	
The stems and branches contained.	29·55	,,	,,
The roots contained ...	... 31·08	,,	,,

The different parts dried at 100° C. had the following composition :—

	Leaves.	Stems and Branches.	Roots.
Organic and volatile matter	94·27	97·22	95·18
Ash	5·73	2·78	4·82
	100·00	100·00	100·00
Containing :—			
Total Nitrogen ...	2·67°/$_o$	0·75°/$_o$	1·06°/$_o$

PERCENTAGE COMPOSITION OF ASH FROM THE WHOLE PLANT.

Soluble and insoluble silica ...	36·25
Oxides of iron and alumina ...	12·95
Lime	15·72
Magnesia	2·53
Potassium oxide	10·93
Sodium oxide	1·23
Sulphuric anhydride	2·11
Phosphoric anhydride	7·10
Chlorine	1·10
Carbon dioxide	10·08
	100·00

JOSEPH DE VERTEUIL,
Asst. Govt. Analyst.

6th August, 1909.

Report on Castilloa Rubber from Tobago by Professor Wyndham R. Dunstan, M.A., F.R.S.

THE specimens of Castilloa Rubber which are the subject of this report were forwarded for examination to the Imperial Institute by the Director of Agriculture in Trinidad with letters No. 629 of the 26th June, 1909, and No. 2338R of the 6th September, 1909. It was stated that the rubber had been prepared by a new centrifugal process, of which particulars were furnished by the Director of Agriculture.

DESCRIPTION AND RESULTS OF EXAMINATION.

A.—Specimen forwarded with letter No. 629 of 26th June, 1909. The sample bore the following label:—"Department of Agriculture. Castilloa rubber prepared by a new process. From Tobago, 26/6/09." Weight 48 grams.

It consisted of a square sheet of very pale rubber, clean and excellently prepared. The rubber was rather weak and much inferior in physical properties to good Para.

The results of the chemical examination were as follows:—

Moisture	0·1
Caoutchouc	70·7
Resin	28·6
Proteids	0·5
Ash	0·1

The analysis shows that the rubber contains a high percentage of resin, which adversely affects its physical properties. The percentages of moisture, proteids and ash are extremely low and it is evident that the rubber has been very well prepared.

In view of the high percentage of resin present in this rubber it would be of interest to learn the age of the trees from which the latex was obtained.

Nos. 1, 2, 3, and 4.—Forwarded with letter No. 2338R of the 6th September, 1909.

No. 1.—"Not creamed. Spun within an hour of tapping. Trees 7–8 years old." Weight 22 grams.

A thin sheet of pale brown rubber, clean and well-prepared. The rubber was stronger than the previous specimen A, but still a little weak. The sample was too small for analysis.

No. 2.—"Creamed, spun same day. Trees 7–8 years old." Weight 19 grams.

Very similar to sample A in appearance and physical properties. The sample was too small for analysis.

No. 3.—"creamed, spun next day. Trees 7–8 years old." Weight 18 grams.

A thin sheet of brown rubber, rather soft and weak. The specimen was insufficient for chemical examination.

No. 4.—"Creamed and washed over and over again, spun next day. Trees 7–8 years old." With this specimen is included another which was labelled as follows :—

"Same as No. 4, but deposited on brass plate fitted inside bowl."

These two specimens had become firmly adherent and could not be separated from one another. They were exactly similar in appearance and were treated together. The united sample weighed 36 grams.

The rubber was pale, slightly sticky, soft and weak. In physical properties, it was the worst of the series.

A chemical examination showed that the rubber contained 0·04 per cent of moisture, and 32·2 per cent. of resin. The quantity of material was not sufficient for complete analysis.

Commercial Value.

The specimens, with the exception of No. 4, were valued as follows :—

	A. Fine thin sheet ...	... 6/10 per lb.
No.	1. Fine thin brown sheet ...	... 6/10 ,,
,,	2. ,, ,, ...	... 6/11 ,,
,,	3. Thin sheet of rather soft character...	6/4 ,,

Specimen No. 4 was of very inferior quality on account of its soft and resinous character, and would realise a much lower price than those quoted for the other specimens.

On the date of the above valuations fine hard Para was quoted at 8/10 per lb. in London.

Conclusions.

Three of these specimens of Castilloa rubber, viz., Nos. 1, 2 and A, are of excellent quality, and it is clear that the centrifugal method adopted for their preparation is capable of yielding very good results. Unfortunately the latex used for the experiments, judging from the composition of sample A, is very resinous so that the resulting rubber is inclined to be soft and weak.

It is not possible from the examination of such small specimens to express any definite opinion regarding the best method of preparation. Sample No. 1, "Not creamed. Spun within an hour of tapping," was little stronger than specimens No. 2, "Creamed, spun same day," and sample A, both of which however were slightly superior to it in colour. No. 3, "Creamed, spun next day," was darker and much weaker than the preceding three specimens, while No. 4, "Creamed and washed over and over again, spun next day," was the worst specimen of the series as regards physical properties.

It would therefore appear that the specimens prepared from the latex on the day of collection are much superior to those in which the latex was kept until the next day. Further experiments will be necessary to determine whether it is advantageous to cream the latex before spinning. The creamed sample No. 2 is superior in colour to No. 1 which was not creamed, and on that account was valued at 1d. per lb. more, but the rubber was not quite so strong as No. 1. Unfortunately the specimens Nos. 1 and 2 were too small for analysis

so that it was not possible to determine the composition of the "creamed" and "uncreamed" rubber for comparison. Larger samples (about lbs. each) of rubber prepared by these methods should be submitted for this purpose.

In view of the successful results obtained by this method of preparation, it would be of considerable interest if further experiments could be conducted on the same lines with latex derived from older trees, as such latex would probably be less resinous and would therefore yield a better product.

It may be further suggested that in dealing with latex containing considerable amount of resin it would be worth while to make some experiments with the object of devising a method of eliminating a portion of the resin, if possible, during preparation; for example, some of the resin might be held in solution by adding a dilute solution of caustic soda (or 3 per cent.) to the latex before spinning, take care not to use sufficient of the alkaline solution to cause rapid coagulation. Specimens of rubber made from the latex without any addition and with varying quantities of the alkaline solution might be submitted for comparative examination. The rubber would require to be well washed after treatment with alkali.

WYNDHAM R. DUNSTAN.

31st December, 1909.

Notes and Comments.

LABORATORIES for the Mycologist and Entomologist of the Board of Agriculture have been fitted up at the Experimental Station buildings at St. Clair where the Government Botanist and Assistant Director of Agriculture and the Curator of Gardens also have their offices and laboratories.

The library of the Botanical Department with the scientific books belonging to the expert officials is also located here and when this is catalogued and arranged it will form an important working tool in the investigations carried on at the laboratories.

The present building is too small to give adequate space, but it is hoped that during this year increased accommodation will be provided so that all the research work necessary on the various existing and proposed cultivations in Trinidad will be able to be carried on in the most expeditious manner possible.

THE appointment of Mr. P. L. Guppy of the Education Department who has for some years been a diligent student of entomology and who has contributed some useful papers on local Lepidoptera to the Entomological Society (London), to assist Mr. F. W. Urich, Entomologist to the Board of Agriculture in his technical work, cannot fail to strengthen the staff of experts engaged in economic scientific work in relation to Agriculture in Trinidad.

MR. H. CARRACCIOLO, who was appointed by the Board of Agriculture as assistant to the staff, went through a course of Scientific Agriculture at Wye Agricultural College, England, which is one of the most efficient of these training institutions in Great Britain. Mr. Caracciolo is engaged in assisting the Mycologist and Entomolgist in their laboratory research, being in charge of cultivations of parasitic fungi and the breeding of insects necessary to elucidate the life history of these organisms preying on cultivated plants.

THE following notes contributed by Mr. Thomas Thornton, A.R.C.S., of Tobago, will be of interest to cotton growers in that Colony:—

"Owing to the large number of red insects called cotton stainers which appeared in the cotton fields last season, the cotton growers of Tobago are strongly recommended to combine together in checking them.

"The stained cotton is caused by these insects sucking the oil from the seeds, and some of the oil getting on to the cotton and staining it. Besides staining the cotton, these insects cause a large number of young balls to fall off the plant, and much of the crop may be lost in this way.

"They multiply very rapidly, and every effort should be made to check them at the beginning of the season. Attention now may save endless trouble and disappointment later. They may be destroyed in the following way:—Place small handsful of cotton seed about the young plants, the insects will congregate upon these, when they may be destroyed by throwing boiling water upon them.

"Cotton seed for this purpose can be obtained free by applying to the Curator of the Botanic Station. It is important that a picket should be fixed in the ground wherever the seed has been placed to trap the insects, to ensure that none of the heaps are forgotten.

"Carelessness in looking after the traps will simply be assisting the insects to live and multiply.

"Those who planted cotton last season should see that all the old plants are pulled up, otherwise the insects will live upon them until the new cotton has grown up, when they will pass over from the old to the young cotton and spoil the new crop."

MR. E. C. SKINNER, representative of the Royal Mail Steam Packet Company, points out that in our last issue, page 70, the carriage of oranges is given as $1 20 per case which is the rate which his Company charges for a single box, and that this would be considerably less in the case of large shipments which would be taken at 30/- per ton measurement or about 60 cents per box, a cost of less than half the charge mentioned by the local planter who supplied the figures to the Bulletin.

MR. FRANK EVANS, Curator of Botanic Gardens, has accepted the appointment of Agriculturist in charge of the sugar experiments of the Hawaiian Sugar Planters' Association. Mr. Evans will not sever his connection with Trinidad, the Government having allowed him a year's leave so that should he not remain in Hawaii at the end of his year's work there, he can return to his appointment here. The Hawaiian Sugar Planters' Association has carried out for some years a most valuable series of experiments on various questions of importance in sugar cane cultivation—the published results of which are of much interest and importance. Mr. Evans is to be congratulated on the fact of his being asked to take up this appointment, and in the event of his returning to Trinidad, the knowledge and experience which he will have gained in Hawaii will be of great value to sugar planting in Trinidad.

At a meeting of the Board of Agriculture held in the Council Chamber (Government Buildings), on Friday, 16th July, 1909.

PRESENT :

HIS EXCELLENCY THE GOVERNOR, (President) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon'ble G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, CARL DE VERTEUIL.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. L. BERT DE LAMARRE.
,, J. D'ABADIE.
,, V. X. DE VERTEUIL.
,, WILLIAM GREIG.
,, J. MOODIE.
,, H. E. MURRAY.
,, A. E. COLLENS (Secretary).

Confirmation of Minutes.

The Minutes of the previous meeting having been printed and circulated among the members were taken as read and confirmed.

Expenditure.

The total expenditure to date amounted to $3,297 22.

Recommendations of Advisory Committee.

The following recommendations of the Advisory Committee were approved :—

(1.) That the consideration of the agreement between the Mycologist and the Board be postponed pending the receipt of a further reply.

(2.) That in view of the old office of the Superintendent of the Botanic Gardens being required by Government House, application should be made for the temporary use, as an office, of the residence of the late Curator.

(3.) That the question of Subsistence Allowance to the Entomologist be deferred to the next meeting.

(4.) That a microscope be obtained at the request of the Entomologist, the cost not to exceed $120.

(5.) That the Mycologist's account for $13.98 travelling and other expenses for the period April 12th to June 30th, be passed.

(6.) That in future all advertisements relating to the Board's business should be signed by the Vice-President or Secretary.

(7.) That in consideration of the long distances between the Estates on which Spraying Experiments had been proposed at the last meeting, the views expressed by the Mycologist in his report on the scheme be approved, and that for the present the Experiments be carried out as he suggests.

(8.) That Mr. B. H. Stephens' offer of $50, for Agricultural Prizes in connection with the Department of Agriculture be accepted, and acknowledged with thanks.

(9.) That the statement by the Agricultural Inspector at Caparo of the presence of Canker in forest trees (Bois Mulatre) be considered, and the Mycologist be asked to report on the matter.

(10.) That the Secretary of the Couva Branch of the Workingmen's Association be informed in reply to his letter of 10th July, that it had already been considered advisable that the members of the Board should represent industries and not districts.

(11.) That owing to the inability to obtain tenders for providing chairs on Band days at the Botanic Gardens no further steps be taken.

(12.) That the Secretary be allowed 12 days leave of absence in August, arrangements to be made by him for the proper carrying out of the Board's work during that period.

Mr. Henderson submitted a return of the acreage in Seedling Canes in *Esperanza*, and suggested that the Board should apply for such information to the different Estates and collect statistics relating to these Seedlings and other agricultural matters.

He also suggested and it was agreed to recommend that Prizes should be offered to Cane Farmers and Cacao Contractors for best cultivated contracts.

The Committee regrets its inability to recommend :—

(1.) Any increase to the $10, provisionally allowed to the Agricultural Inspectors, to cover travelling and other expenditure.

(2.) The purchase of a typewriter at the request of the Mycologist, but are of opinion that the assistance required in copying reports, correspondence, etc., should be given at the Central Office of the Board.

An offer of 6 kegs of Copper Sulphate at 9 cents per pound was received from Messrs. Gerold and Scherer. It was decided not to entertain the offer.

Monthly Reports.

The monthly reports of the Entomologist, Mycologist, and the Agricultural Inspectors which were previously circulated were taken as read and ordered to be printed.

Visit to Chaguanas—Re-appearance of froghoppers.

In connection with a statement in the Entomologist's report as to the re-appearance of froghoppers, the Vice-President stated that in company with the Entomologist and the Secretary, he had visited Chaguanas on Wednesday 14th, and conducted several experiments with insecticides on the immature froghoppers which were present in large numbers in one part of the field.

The results of these experiments tended to prove that water solutions of insecticides were not effective, but that an emulsion of Lysol and Kerosene Oil was destructive in a very short time. Vaporite and Cyanamide were tried, and a direct application killed the froghoppers fairly rapidly. The latter is to be preferred if sufficiently destructive, as it is a valuable nitrogenous manure. The Department had also imported a 1,000 candle power lamp, which would be tried early next week, and the froghoppers would be kept under close observation.

Castnia licus returns.

The Entomologist had submitted a return of the number of Castnia licus moths destroyed on the Caroni Estate, which showed that 91,000 had been collected for the period November, 1908 to July 9th, 1909.

The Secretary read the letter of appointment of Mr. V. X. de Verteuil to act during the absence of the Honourable R. S. A. Warner, K.C.

The Secretary reported the receipt of the following for Experimental Purposes :—

Receipt of Badilla Cane from Queensland, also new types of Seedling Canes and Rice from British Guiana.

(a.) 28 Cuttings of the Badilla Cane from Queensland.

(b.) Cuttings of 41 new varieties of Sugar Canes from British Guiana.

(c.) Six selected types of Rice from British Guiana.

It was decided that the thanks of the Board should be conveyed to the Departments of Agriculture of Queensland and British Guiana.

Resolution of Mr. H. E. Murray on the better drainage of lands, etc.

A resolution by Mr. H. E. Murray for the better drainage of estates and other lands was referred to the following Committee for consideration :—

The Honourable G. T. Fenwick.
,, ,, S. Henderson.
Mr. V. X. de Verteuil.
,, J. Moodie.
,, H. E. Murray.

Vote of thanks to Mr. Jardine for his paper on natural regeneration of worn out Cacao Soils.

Mr. W. C. Jardine's paper on the "Natural Regeneration of Worn Out Cacao Soils" which had been previously circulated, was brought up for discussion. It was unanimously agreed that the thanks of the Board should be conveyed to Mr. Jardine for his interesting paper.

The following correspondence was dealt with :—

Correspondence—Sir N. Lubbock.

(1.) Letter from Sir N. Lubbock, thanking the Board for their letter of appreciation of his services during his Chairmanship of the West India Committee, and stating his desire to promote in any way the interests of Trinidad or any other West Indian Colony.

(2.) Letters from Messrs. H. E. Murray and Bert de Lamarre asking for leave of absence as follows :—

Messrs. Bert de Lamarre and Murray—*Re* leave of absence.

Mr. Murray for 4 months dating from the end of July.
Mr. Bert de Lamarre from 27th July to 15th November.

On the suggestion of these gentlemen it was decided to recommend the appointment of Messrs. F. J. Morris and C. W. Haynes to act for them respectively.

Mr. V. Gormandy's application for Assistant Inspectorship.

(3.) Application from Mr. V. Gormandy for the post of Assistant to the Agricultural Inspectors.

The Secretary was directed to inform Mr. Gormandy that there was no such vacancy at present.

Mr. S. A. Cole—*Re* Cacao Contracts.

(4.) Application from Mr. S. A. Cole for a Cacao Contract under the Board.

It was decided to inform Mr. Cole that the Board has no Cacao Contracts to offer at present.

(5.) Letter and Circulars from Messrs. Moller and Struck *re* Cacao Sprayers. — Messrs. Moller and Struck *re* Sprayers.

(6.) Letter from Mr. L. de Verteuil, regretting his inability to attend the meeting. — Mr. L. de Verteuil's absenc from meeting.

The following specimens were exhibited :— — Specimens on exhibition.

(1.) Sample of Palmine or Vegetable Butter prepared from Coconut Oil.

(2.) Specimen of a plant forwarded by Mr. J. J. McLeod for identification and analysis, and which was stated to have extraordinary effects in increasing the growth of cultivated crops planted in its vicinity.

The meeting then adjourned. It was decided to hold the next meeting on Friday, 13th August.

A. E. Collens,
Secretary (*pro tem.*)

At a meeting of the Board of Agriculture held in the Council Chamber (Government Buildings), on Friday, 13th August, 1909.

PRESENT :

HIS EXCELLENCY THE GOVERNOR (President), *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon'ble G. T. FENWICK, C.M.G.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. J. P. BAIN.
,, J. D'ABADIE.
,, L. DE VERTEUIL.
,, V. X. DE VERTEUIL.
,, WILLIAM GREIG.
,, C. W. HAYNES.
,, J. MOODIE.
,, J. J. MCLEOD.
,, F. J. MORRIS.
,, L. SEHEULT, B. Sc.
,, L. SELLIER.
,, J. H. WADE.
,, A. E. COLLENS (Secretary).

Confirmation of Minutes.

The Minutes of the previous meeting having been printed and circulated among the members were taken as read and confirmed.

Finance.

The following financial statement was submitted :—

Balance in Bank, 30th June, 1909 ...	$12,214 70
Agricultural Tax for June, 1909 ...	1,525 06
	$13,739 76
Payment by cheques during July, 1909.	1,161 84
	$12,577 92

Advisory Committee.

The Secretary announced that owing to the unavoidable absence of several of the members, the meeting of the Advisory Committee, which was to have taken place that morning, had been postponed.

The Vice-President stated that in order to meet contingencies like this, it would be necessary to increase the number of members.

After discussion, it was moved by Mr. V. X. de Verteuil :— Increase of members of Advisory Committee.

"That the number of members on the Advisory Committee be increased to ten."

Lieut.-Collens then proposed the following amendment :—

"That the number be increased to seven, and that three form a quorum."

A proposal "that the numbers should be increased to eight" was finally decided by a majority of 9. Messrs. J. P. Bain and V. X. de Verteuil were appointed as additional members. Messrs. J. P. Bain and V. X. de Verteuil nominated members.

The monthly reports of the Entomologist, Mycologist and Agricultural Inspectors, having been previously circulated were taken as read and ordered to be printed. Monthly reports.

In reply to a question from Mr. Seheult as to whether the Agricultural Inspectors remained sufficiently long in each district to thoroughly instruct the small proprietors, the Vice-President stated that the practice had been to remain in the district till the work of inspection was finished as far as it could be The addresses of the Inspectors had been advertised in the newspapers, but one of the chief difficulties was to get the planters to know of their presence in the district, or to meet them on their estates, and he invited the co-operation of the members of the Board in this matter. Inspector's stay in district.

Mr. D'Abadie suggested that the Inspectors should distribute the pamphlets on diseases, etc. This was agreed to.

An account of the Mycologist for $8.16 travelling expenses was passed. Mycologist's account.

It was decided to recommend to the Government, the publication of Mr. Vincent's book on the Sea Fishes of Trinidad, provided it could be done at a reasonable cost, as it would be for the benefit of the Colony generally. M.P. 4353/09—Book on Sea Fishes of Trinidad.

Mr. Fenwick drew the attention of the Board to the damage that was being done to the fishing industry by the use of seines with small meshes. Depletion of fish owing to use of small meshed seines.

The Board recommended that the attention of the Government be invited with a view to legislation for regulating the size of the meshes in fishing nets.

The Secretary stated that notification had been received from the Hon'ble the Colonial Secretary of the appointment of Messrs. Morris and Haynes to act on the Board, and that the appointments had been announced in the *Royal Gazette*. M.P. 4135/09 Appointment of Messrs. Morris and Haynes to act on the Board.

The question of the use of the house used by the late Curator, and recently removed to the north-west of the nurseries, was referred back to the Advisory Committee. M.P. 3438/09—Building used as late Superintendent's Office.

Letters were read from :—

1. The acting Island Analyst of Jamaica, stating that he was forwarding a fresh culture of Rat Virus for experimental work. Rat Virus preparation.
2. The Hon'ble acting Surgeon-General, that the Pathologist was prepared to undertake the preparation of Rat Virus locally, if the Board will supply the Test Tubes, and on payment of two shillings for each dozen tubes of virus supplied.

The Vice-President reported that the Kitson Lamp had been erected at Chaguanas, but was at present temporarily out of order, Report on Kitson Lamps.

and that Hurricane Lamps had also been tried with some success against the Froghoppers, and asked the Board for authority to expend a sum of $48 for purchase of lamps, and also $100 for insecticides, etc., in the campaign against the froghoppers, if these expenditures should be found necessary.

Return of acreage under Seedling Cane cultivation.

The Secretary announced that in response to the Circular issued asking for information *re* acreage under Seedling Cane Cultivation, replies had been received from Messrs. W. S. Robertson & Co., G. Liddlelow, Gordon Grant, James Black, S. Henderson, Bert de Lamarre, and F. J. Le Blanc.

Mr. C. C. Stollmeyer's paper on "Shade or No Shade."

A paper on "Shade or No Shade" by Mr. C. C. Stollmeyer was read and ordered to be printed in the *Bulletin*. The Secretary was instructed to convey the thanks of the Board to Mr. Stollmeyer for his interesting contribution, and to suggest that records might be kept of the return per 1,000 of a fixed number of bearing trees say 10,000:

(1.) of last year whilst under shade,
(2.) of each succeeding year,

noting as far as possible the extent of the shade each year until entirely removed.

Sale of Cotton —Tobago.

The Broker's report of the British Cotton Growing Association dated 15th July was read reporting the sale of 5 bales of Tobago Cotton at 15 pence per pound.

Analysis of *River* estate soils.

The results of the analyses of the soils from *River* estate were ordered to be printed in the *Bulletin*.

Correspondence.

(1.) A letter from Mr. C. Carmona reporting the presence of Canker in the *bois Mulatre* trees in the Arena district was referred to the Department to deal with.

(2.) Letter from Mr. C. d'Hereux reporting infection of his cacao trees at Santa Cruz from neglected surrounding properties. Referred to the Plant Protection Committee.

The meeting then adjourned. It was decided to hold the next meeting on Friday, 10th September, 1909.

A. E. Collens,
Secretary, (*pro tem.*)

At a meeting of the Board of Agriculture held in the Council Chamber (Government Buildings), on Friday, 10th September, 1909.

PRESENT :

HIS EXCELLENCY THE GOVERNOR (President), *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon'ble G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, ,, C. DE VERTEUIL.
,, ,, WILLIAM KAY.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. J. P. BAIN.
,, J. D'ABADIE.
,, L. DE VERTEUIL.
,, V. X. DE VERTEUIL.
,, WILLIAM GREIG.
,, C. W. HAYNES.
,, F. W. MORRIS.
,, E. L. SELLIER.
,, L. SEHEULT, B.Sc.
,, A. E. COLLENS, Secretary.

Welcome to Mr. Carruthers. His Excellency on behalf of the Board extended an official welcome to Mr. Carruthers and appointed him a member of the Board.

Appointment as a Member of the Board. Mr. Carruthers then took his seat at the Board.

The President stated that the Tobago Planters had asked that a representative for Tobago be appointed on the Board, and that he would be pleased to appoint one if the planters would take steps to nominate a representative.

Confirmation of Minutes. The Minutes of the previous meeting having been printed and circulated among the members were taken as read and confirmed.

Financial Statement. The following financial statement was submitted :—

Balance in Bank 30th July, 1909 ...	$12,577 92
Agricultural Tax for July, 1909 ...	1,082 28
	$13,660 20
Payment by cheques during August ...	1,047 99
	$12,612 21

Report of Advisory Committee. It was agreed that the report of the Advisory Committee be dealt with by the whole Board in Committee.

Monthly Reports. The monthly reports of the Entomologist, Mycologist and Agricultural Inspectors having been previously circulated were taken as read and ordered to be printed.

The following return of Froghoppers caught on the 8th and 9th September was added to the Entomologist's report :—

			25 Hurricane Lamps.
September 8th ...	...	...	19,670
" 9th ...	...	...	15,557
Total	...	...	35,227

The Vice-President mentioned that neither the Kitson nor Acetylene Lamps had proved as effective as ordinary Hurricane lamps, and that arrangements had been made for the Estate proprietors to take over the existing lamps. Hon'ble S. Henderson stated he would use 100 lamps in future.

Hon'ble C. de Verteuil stated that the suggestion embodied in the Mycologist's report,—that in each district, which the Agricultural Inspectors visit, one small holding might be put in a thorough sanitary condition as a practical example to the smaller proprietors,— was an excellent one and should be acted upon.

Mr. Carruthers suggested that East Indian labourers from various estates should meet the Agricultural Inspectors and be personally instructed in excising canker, etc., and that they in turn would be able to utilise this knowledge on the Estates on which they were employed.

Agricultural Education Scheme.

In reply to a question by Mr. V. X. de Verteuil as to whether any steps had been taken in connection with the scheme for Agricultural Education, the Vice-President stated that a meeting of that Committee had taken place that morning, at which the preliminary details had been discussed, and that information had been collected from neighbouring Colonies.

Account for Analyses.

An account from Mr. J. de Verteuil for $50 for Analyses of soils, etc., was passed. In reply to a question from the Hon'ble C. de Verteuil as to the reason for these analyses, the Vice-President stated that he had personally selected these soils, the composition of Tobago Soils was not known as no samples had been previously analysed.

Appointment of Secretary.

The question of the appointment of a Secretary was postponed.

Reports, etc.

The results of the analyses of Tobago Soils, and of a leguminous plant (*Flemingio strobilifera*) and also Returns of the acreage planted with Seedling Canes were laid on the table and ordered to be printed.

Correspondence.

The following correspondence was dealt with :—

(1.) Letter from the Island Chemist, Jamaica, reporting that 6 tubes of Rat Virus had been forwarded and that it had been found that the Virus killed Mongoose when the latter were fed on inoculated rats.

The Vice-President mentioned that the Virus had been received and handed over to the Government Pathologist who had reported that it was reliable. Out of 17 rats inoculated 14 had died in 4 days. Tubes of freshly prepared Virus would be available for use in a few days and it was proposed to temporarily issue infected rats to be liberated in places where they had been reported upon as a nuisance.

(2.) Letter from Mr. A. P. Ditzen, offering to conduct experiments on "Shade or no shade" under the Board's employ.

The Secretary was directed to thank Mr. Ditzen for his offer and to state that the Board was unable to make the experiments suggested.

The Assistant Director reported on his experiences of Shade and no shade in Ceylon and suggested that the data obtained by local investigators on the subject might be collected and published.

(3.) Letter from Mr. J. Moodie applying for leave of absence till the 31st December.

(4.) Letter from Mr. William Thompson, England, inquiring if there was any likelihood of employment on the Government Farm or elsewhere in carrying out experiments in Cattle Breeding.

The Secretary was directed to inform Mr. Thompson that there was no likelihood of employment.

(5.) Letter from Mr. Paul Scheerer placing his estate at Erin at the Board's disposal for conducting Spraying Experiments.

It was decided that Mr. Scheerer should be thanked for his offer, and informed that the Board is not prepared to carry out any new experiments at Erin, but that the Officers of the Department of Agriculture would be pleased to afford all assistance or information in outlining such experiments.

(6.) Minute from the acting Warden of Toco *re* the presence of disease among Coconut trees.

To be referred to the Mycologist.

Rubber possibilities in Trinidad.

The Assistant Director then addressed the Board on the possibilities of Rubber cultivation in the Colony.

Mr. Carruthers was thanked for his address, and it was decided to forward the following recommendation to the Government—That 500,000 Para Rubber seeds be ordered by cable.

Mr. V. X. de Verteuil suggested that arrangements be made as early as possible for the Assistant Director to visit Rubber estates in Trinidad and Tobago and advise them on the cultivation and tapping of Rubber.

Accommodation of Members.

Mr. V. X. de Verteuil drew the attention of the Board to the want of proper accommodation for members, and suggested that an extra table be provided.

Report of Advisory Committee.

The Board then went into Committee on the report of the Advisory Committee.

The Agreement of the Mycologist's contract was considered, and it was decided to await an inquiry which Mr. Carruthers offered to make.

The following motion was agreed to :—

(1.) That the Vice-President be authorized to expend a sum not exceeding $1,500 in fitting up, the room, used as a Herbarium at the Experiment Station, as a Laboratory for the Mycologist and Entomologist.—Moved by Mr. L. Scheult, and seconded by the Hon'ble S. Henderson,

(2.) The following recommendation of the Advisory Committee *re* the Entomologist's subsistence allowance was agreed on the motion of Lieut.-Colonel Collens, seconded by Mr. L. Seheult:—

(*a.*) That previous to the 1st of September, Mr. Urich should be granted subsistence allowance while travelling in accordance with Ordinance 171, and subject to the approval of the account by the Hon. Auditor-General.

(*b.*) That from the 1st of September, out of pocket expenses actually incurred should be refunded to Mr. Urich, instead of subsistence allowance.

Application for employment as an Agricultural Inspector to East Indian Agriculturists from Mr. James Mungal, and from Mr. Frederick Cæsar, as an Agricultural Inspector—not recommended as there are no vacancies.

The meeting then adjourned at 4.30 p.m., to Friday, 8th October, 1909.

A. E. Collens,
Secretary (*pro tem.*)

At a meeting of the Board of Agriculture held in the Council Chamber (Government Buildings), on Friday, 8th October, 1909.

PRESENT :

HIS EXCELLENCY THE GOVERNOR, (President) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President).
Mr. J. P. BAIN.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. WILLIAM GREIG.
,, C. W. HAYNES.
The Hon. Mr. S. HENDERSON.
,, ,, WILLIAM KAY.
Mr. J. J. McLEOD.
,, F. J. MORRIS.
The Hon. Mr. C. DE VERTEUIL.
Mr. L. DE VERTEUIL.
,, THOMAS THORNTON.
,, J. H. WADE.
THE ASST. DIRECTOR AND GOVT. BOTANIST, (Hon Sec.)
Mr. A. E. COLLENS (Secretary *pro tem.*).
THE MYCOLOGIST.
,, ENTOMOLOGIST.
,, CURATOR OF GARDENS.

His Excellency announced that it had been decided to place the Council Table at the disposal of the Board in order to afford better accommodation for the members, and on behalf of the Board extended a welcome to Mr. Thomas Thornton, who had been elected to represent the Planters' Association in Tobago. **Use of Council Table.** **Welcome to Mr. Thornton.**

His Excellency also informed the Board that Mr. Carruthers had accepted the position of Honorary Secretary to the Board. **Mr. J. B. Carruthers appointed Honorary Secretary.**

The Minutes of the previous meeting were taken as read, and confirmed. **Confirmation of Minutes.**

The financial statement was submitted. **Financial Statement.**

Balance in Bank, 30th August	...	$12,612 21
Agricultural Tax for ,,	...	525 12
		$13,137 33
Payment by cheques during September		710 92
		$12,426 41

The monthly reports of the Agricultural Inspectors were laid on the table. **Monthly Reports.**

The report of the Committee on Agricultural Education was read. The adoption of this report was moved by the Hon. Mr. C. de Verteuil and seconded by the Hon. Mr. S. Henderson, and it was ordered to be printed and circulated before the next meeting, and to be brought up again for further consideration. **Report of Committees.**

The report of the Committee on the Truck System was read.

Castnia licus returns.

Froghoppers returns.

The Secretary submitted a return showing the number (154,166) of *Castnia licus* moths caught at *Caroni* estate from November last to date, and also a detailed statement of the number of froghoppers caught with the use of trap lamps in the Caroni, Chaguanas and Claxton Bay districts.

Reports to be presented by technical officers.

It was decided that in future these reports be presented and read by the Scientific Officers in charge of such work.

Rat Virus.

The Secretary reported that 72 tubes of Rat Virus and also several inoculated rats had been received from the Pathologist to date, and distributed. Two Manicou Gros Yeux had also been received from *Moka* estate and returned after inoculation with Virus, but the inoculation of these animals had been discontinued, as the Pathologist had reported that the experiments on them were unfavourable.

Results of analyses of filter press cake.

The results of the analyses of a sample of filter press cake were read and ordered to be printed in the *Bulletin*. The Director of Agriculture mentioned that this wax could be used to make phonograph and other records and was valued at 3/6 to 4/- per lb.

Report on Carpenter Bird.

A report on the replies received in answer to a Circular issued in January, 1909, *re* the Carpenter Bird was laid on the table.

The following matters which had previously been considered by the Advisory Committee were dealt with :—

Applications from the Local Secretary, Princes Town Agricultural Shows for a contribution by the Board to that Show.

The Board was of opinion that is not within its statutory powers under the Ordinance to make grants to Agricultural Shows.

Application from the Permanent Exhibition Committee for assistance from the Board in preparing exhibits for the Fruit Show to be held in London in December, 1909. The Board decided that it is unable to contribute any of its funds to the Permanent Exhibition Committee.

The Board appointed Mr. H. Caracciolo, (Jnr) late of Wye College, England, Scientific Assistant to the staff of the Board at a salary of £5 per month.

In reply to a question from the Honourable Mr. S. Henderson as to whether the Laboratory at St. Clair was ready yet, the Assistant Director stated that alterations were nearly completed, and laboratory tables put in, &c. The necessary apparatus had been ordered and a list of books required was being prepared.

Rubber curing house.

The Assistant Director informed the Board that there were several rubber trees adjacent to the St. Clair Office suitable for tapping experiments, and that it would be desirable to erect a curing house to conduct experiments with rubber latex, and asked the Board for a grant for the purpose of erecting a wooden building and installing the necessary machinery for these experiments.

After discussion the following motion was agreed to:—"That authority be given to incur expenditure to erect a wooden curing house with fittings, etc., the cost not to exceed $1,000.—Moved by Lt.-Colonel J. H. Collens, and seconded by Mr. J. J. McLeod."

The question of providing an Assistant to do clerical and other experimental work at a salary of £70-£100, was postponed.

The Board passed the account for $62 36, expenses in connection with working the Kitson Lamp and clean weeding cane fields at *Woodford Lodge* estate, in froghopper extermination experiments.

The Hon. Secretary was requested to send a letter of thanks to Mr. Paul de Verteuil, for his report and valuable assistance in connection with these experiments.

The Board passed the payment of the two accounts for subsistence allowance submitted by Mr. Urich.

The Honourable C. de Verteuil gave notice of his intention to prepare a resolution for the next meeting of the Board that a Committee be appointed by the Board to frame rules for the guidance of the Board's Officers; but the Hon. Secretary asked leave to submit such rules after conferring with other members, and this met with the approval of the Board.

Correspondence.

The following correspondence was read:—

(1.) Letter from Mr. A. P. Ditzen placing his services at the disposal of the Board.

Referred to the Honorary Secretary.

(2.) Letter and chart showing the fluctuations in rubber during 1908 from Messrs. Gerold and Scherer.

The Director of Agriculture informed the meeting that Mr. Majani, on behalf of the American Agricultural Chemical Company, of New York, had offered to present the following manures to the Board for experimental purposes:—

6 Bags (Analysis attached) for Cane, Cacao, and fruit trees.
2 Barrels fungicides for experimental purposes.

The Board accepted the offer with thanks to Mr. Majani.

The Secretary announced that Mr. L. Seheult and also Mr. J. D'Abadie had asked to be excused from attending the meeting.

The Assistant Director of Agriculture stated that he had made several tours in the various rubber districts and had found the rubber trees growing very well, that the General Manager of the Railway was having tapping instruments made for him, and that he would be very glad if members making any discoveries in tapping experiments would communicate their ideas to the Department.

Mr. Henry L. Smith of Tobago who was present mentioned that he expected to receive one of his rubber coagulating and drying machines soon, and that he would be pleased to place it temporarily at the disposal of the Board for experimental purposes.

The Assistant Director of Agriculture made some remarks as to Cacao selection, and suggested a method of discovering the yielding qualities of trees which could be adopted with very little trouble on every Cacao Estate. In answer to a question he stated that from his experience in Ceylon, Trinidad Estates as far as he had seen up to the present, suffered comparatively little from canker. In Ceylon they would consider such estates very free from canker.

Mr. Thornton mentioned that he had conducted experiments in Cotton growing, and that he had succeeded in raising the price of cotton on one estate to 1/6 per lb., while the lint grown on surrounding estates was only valued at 1/2 per lb.

Exhibits.

The following exhibits were shown :—

(1.) Sample of wax extracted from filter press cake.

(2.) Manures prepared from air (Nitrogen), comprising Calcium Nitrate and Calcium Cyanamide.

(3.) Mounted specimens of various types of Carpenter Birds, and also specimens received from Mr. A. B. Carr of Gran Couva, and the Curator of the Botanic Gardens, Tobago.

The meeting adjourned at 3.45 p.m. to Friday, 19th Nov., 1909.

J. B. Carruthers,
Honorary Secretary.

At a meeting of the Board of Agriculture held in the Council Chamber, on Friday, 19th November, 1909.

PRESENT :

HIS EXCELLENCY THE GOVERNOR (President), *in the Chair*.
THE DIRECTOR OF AGRICULTURE (Vice-President).
The Hon. Mr. G. T. FENWICK.
,, ,, S. HENDERSON.
,, ,, C. DE VERTEUIL.
,, ,, R. S. A. WARNER.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. J. D'ABADIE.
,, WILLIAM GREIG.
,, C. W. HAYNES.
,, H. E. MURRAY.
,, L. SEHEULT.
,, E. L. SELLIER.
,, L. DE VERTEUIL.
THE ASSISTANT DIRECTOR OF AGRICULTURE (Hon. Sec.)
THE MYCOLOGIST.
,, ENTOMOLOGIST.
,, CURATOR OF GARDENS.

Apologies for unavoidable absence were received from Hon. Mr. W. Kay, Mr. J. P. Bain, and Mr. J. H. Wade. **Apologies received.**

The Minutes of the previous meeting, after alterations of the wording in two cases, were confirmed. **Confirmation of Minutes.**

The financial statement was submitted :— **Financial Statement.**

Balance in Bank, 30th September ...	$12,426 41
Agricultural Tax for ,, ...	297 34
	$12,723 75
Payment by cheques during October...	1,162 89
Balance	$11,560 86

The Mycologist, in reporting as to the progress of his work during the past month said that, in addition to the routine work of the laboratory three field trips had been made; one to Sangre Grande to choose a location for some future spraying experiments on cacao, one to Guanapo to get results of the picking of cacao from sprayed and unsprayed trees, and one to Toco. In regard to the cacao spraying experiments, he had to report a perceptible reduction of "black cacao" on the sprayed trees. **Report of Mycologist.**

The trip to Toco was made to investigate the cause of the death of coconut palms reported by the acting Warden some two months ago. Numerous dead and dying palms were found from Grande Rivière all along the coast to Toco village or a little beyond. The Government plantation at Galera Point was also inspected, but no disease was found though the whole place was in a very neglected state of cultivation. *Woodbine* estate at Balandra Bay and *Espe-*

ranza estate near Matura was also visited, but no serious diseases were found at these places.

In and about Toco, however, the situation is different. Many trees of all ages were dying. An examination of a number of these dying trees showed that the disease was the typical bacterial bud-rot, which has previously been reported from Trinidad and other Islands of the West Indies, from Central and South America, and the East as well. This disease has practically destroyed the coconut industry of Cuba, especially in the Baracoa district where many once prosperous estates are now abandoned. Though the disease has been found here in several different districts it has not yet a firm foot hold so that every possible means should be taken to keep it under control. The putrifying buds of the dead and dying palms serve as a source of infection of healthy trees and should be destroyed, either by burning or burying. Where bud-rot is present young plantations might be protected from attacks of the disease by spraying with Bordeaux Mixture or other fungicides. Trees up to six or seven years old can be thoroughly sprayed at a cost of about one cent per tree per application.

Considering the fact that this disease as yet in Trinidad has affected only a small proportion of trees, and in view of the damage that it has done in other countries, Mr. Rorer proposed that the Board should undertake the destruction of dead and dying palms affected by bud-rot. For this purpose he suggested the temporary employment of one of the Agricultural Inspectors assisted by labourers. Each district should be systematically worked and records kept as to the number of trees examined and the number destroyed.

On the motion of Hon. Mr. C. de Verteuil, seconded by Mr. H. E. Murray, it was resolved :—

> "That a sum of $500 be apportioned for the purpose of carrying out the work of destruction of dead and dying coconut palms under the supervision of the Mycologist."

Report of Entomologist.

The Entomologist reported that, since the last meeting 17,856 *Castnia licus* had been caught in the Caroni district making a total of 172,022 to date, of this number from 33 per cent. to 40 per cent. were females (each female being capable of laying 20–40 eggs. He regretted that only one proprietor in that district systematically carried on such work. Froghoppers (*Tomaspis postica*) were abating, it appeared that the hurricane lamps and clean weeding were responsible for this decrease. The campaign should be undertaken in crop time, and recommendations should be submitted to the Board in time for the dry season. An outbreak of Thrips (a minute leaping insect), had recently occurred on cacao in the Guaico district. This had done considerable damage in Grenada. In Trinidad it was fairly common, but up to now had not appeared in large numbers. The attack at Guaico was sporadic and only about 50 to 60 trees had suffered. Some spraying experiments specially for this pest would be undertaken, so as to be ready for any increase of the insects whenever it should occur. A cacao boring beetle (*Steirastoma depressum*) had been reported as being present in large numbers at Erin It was a serious pest to cacao in some districts, but could be trapped by the thousands on slabs of "Wild Chatagine" (*Pachira acquatica*), placed

in the fields during the day. The Honorary Secretary mentioned that Mr. Coldingnon of Erin has suggested the purchase of numbers of this beetle and its larvæ as a curative measure fcr this pest, and the Entomologist was asked to report to the next meeting of the Board as to the relative prevalence of this living beetle in various districts with a view to measures being taken for its suppression.

On the motion of the Vice-President it was decided to recommend Government to amend Section 4 of Ordinance 38 of 1908 to allow of part of the funds being appropriated for purposes of Agricultural Education and Agricultural prizes.

The Hon. Secretary reported that His Excellency the Governor had sanctioned the erection of the rubber curing house (for which $1,000 was voted at the previous meeting), at the Experiment Station, St. Clair, on the understanding that the building will become the property of the Government, *i.e.*, the Agricultural Department to be used for the purposes for which the Board of Agriculture intended it, the cost of upkeep while used by the Board to be borne by the Board.

On the motion of Mr. W. Greig, seconded by Mr. H. E. Murray, the Board decided to ask the Government to consider the Sale of Produce Ordinance No. 8 of 1909, with regard to its provisions for transactions in Coconuts and Sugar and their products.

His Excellency the Governor appointed the Hon. Messrs. S. Henderson and C. de Verteuil and Mr. W. Greig as a Committee to advise the Government as to the amount of the Agricultural Tax for 1910.

A discussion took place as to the future expenditure on experimental work in connection with Cacao, Coconuts, Sugar, Rubber and other cultivated plants, and it was decided to deal with each proposal for such expenditure when the necessity for it arose.

The Honorary Secretary asked that the Board should appoint Mr. J. Pinder as his assistant to carry out the experimental work, and the Board agreed to his employment temporarily at a salary of $30 per mensem, the matter to be brought forward at the next meeting.

An Exhibition was made in connection with rubber cultivation photographs, tapping instruments and samples of prepared rubber, but the time did not allow of demonstration of these objects, and a report on experiments in tapping Castilloa rubber in Trinidad and Tobago and other items on the Agenda paper were not dealt with.

J. B. Carruthers,
Honorary Secretary.

24th November, 1909.

At a meeting of the Board of Agriculture held in the Council Chamber on Friday, December 17th, 1909.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (President) *in the Chair*.
The Hon. Mr. C. DE VERTEUIL.
" " W. KAY.
" " S. HENDERSON.
" " R. S. A. WARNER, K.C.
Mr. J. D'ABADIE.
" WILLIAM GREIG.
" J. J. MCLEOD.
" H. E. MURRAY.
" L. SEHEULT, B.Sc.
" J. H. WADE.
THE ASSISTANT DIRECTOR OF AGRICULTURE (Hon. Sec.)
" MYCOLOGIST.
" ENTOMOLOGIST.
" CURATOR OF GARDENS.

Memorial Minute on the late Mr. Bert de Lamarre.

Upon taking the chair His Excellency the Governor referred sympathetically to the loss which the Colony had sustained in the death of Mr. Bert de Lamarre, and the following motion was passed:

"The Board of Agriculture wishes to record its sense of the loss to Agriculture by the untimely death of Mr. L. Bert de Lamarre. He possessed, not only an exceptional knowledge of technical matters appertaining to Agricultural Chemistry, but also the practical business ability to utilize such knowledge. His institution of a paper factory on his estate at *Orange Grove* may in the future show him to have been the pioneer of a large and profitable industry for which a tropical country is specially fitted."

His Excellency also informed the Board that he had asked Mr. C. W. Haynes to continue to act until a successor is appointed to Mr. de Lamarre, and read a letter from Mr. Haynes thanking His Excellency for the honour, and asking to be excused from attending the next meeting.

Confirmation of Minutes.

The minutes of the previous meeting were confirmed.

Financial statement.

The financial statement for December was submitted:—

Balance in Bank October 31st	...	$11,560 86
Agricultural Tax for October	...	307 18
		$11,868 04
Payments during October	...	945 19
		$10,914 85

The Mycologist, Mr. J. B. Rorer, reported that since the last meeting another picking has been made from the sprayed and unsprayed cacao trees on Mr. Lange's estate at Guanapo. The beneficial results of the spraying were even more pronounced than at the previous picking. Not only was the black cacao much less on the sprayed trees, but a greater number of pods was gathered from these trees as well. From a total of 1,277 pods picked from the 500 sprayed trees only 73 were affected with black and brown rot, while from a similar plot of unsprayed trees in the same field a total of 1,040 was picked, of which number 262 pods were affected with black and brown rot. To the present time 748 more sound pods have been picked from the sprayed trees than from the control trees. As these results are quite encouraging other experiments are being started in different sections of the Island. Mycologist's Report.

The work on the destruction of diseased coconut palms was started on Tuesday, November 30th, in the Laventille district. To date 445 trees have been cut down and prepared for burning. The crowns of all infected and in some cases whole trees have been buried. So far, only about $30 have been expended.

In the course of some observations on this report, the Hon. Mr. C. de Verteuil mentioned that the results of spraying carried on at his cacao estate fully supported the statements made by the Mycologist as to the beneficial results of this treatment.

Mr. Seheult recommended the carrying on of experimental work in regard to cacao disease in various parts of Trinidad, where climatic and other conditions differed. The Mycologist explained his difficulties in giving the necessary attention to a large number of experiments and impressed upon the Board the importance of his personally superintending the carrying out of each experiment and observing the results. It was decided on the suggestion of the Secretary that the Mycologist and Entomologist should prepare leaflets giving exact instructions as to methods of applying sprays, quantities to be used, &c., and request planters in various districts to carry out definite experiments and forward to them the data obtained.

The Entomologist, Mr. F. W. Urich, reported with regard to his work in connection with the outbreak of Thrips on Cacao. At Guaico, several insecticides had been tried, viz.:—Kerosene emulsion, Lysol and washing soda and Whale oil soap. All were successful in killing the insects on the leaves and pods. The Kerosene emulsion as used had damaged some tender leaves, but not to any great extent, if the mixture was less concentrated this damage might be avoided. The Whale oil soap was cheap and the results satisfactory. Several estates in different localities were visited with a view of determining the prevalence of this insect. It was ascertained that although not numerous none of the places visited were entirely free and some pods were always to be found on which immature forms were feeding. The larvæ seemed to invariably choose the same kind of Cocoa (Forastero). The adults were generally found breeding on young leaves which they damaged permanently. Eggs were deposited principally on pods, on which the larvæ fed until ready to assume the pupal stage when they retired to the underside of a leaf or protected part of the pod and remain quiet until ready to change into the adult stage. The development for hatching of egg to perfect insect takes Entomologist.

Export of fruit—Curator's report.

14–15 days. Spraying experiments and observations on the biology of these insects were being continued.

The Curator of Gardens, Mr. F. Evans, in reporting on export of fruits read a letter from Dr. Fairchild of U.S.A. Department of Agriculture acknowledging the receipt of a box of Mangosteen fruit (*Garcinia Mangostana*), which, owing to the careful method of packing had arrived in excellent condition, and reported that as at present the island possessed only a few trees of this species, it would be some years before any quantity of this fruit could be shipped commercially. Trial shipments of Avocado Pears (*Persea gratissima*); Mangoes (*Mangifera indica*) and Sapodillas (*Achras Sapota*), had also been sent to the United States of America, and the matter had been taken up by a New York Firm, who had made special arrangements with the Royal Dutch Mail Company, for the use of space in their refrigerating rooms. A local agent had been appointed and several thousand Avocado Pears had already been shipped.

The Curator exhibited photographs of the fruit after it had arrived in Washington showing the method of packing and the excellent condition on arrival.

Ordinance on Ankylostomiasis.

The Honorary Secretary laid before the Board draft of an Ordinance relating to the disease known as Ankylostomiasis referred for their consideration by the Legislative Council, and the following were appointed as a Sub-Committee to consider the question and report to the Board:—

Hon. the Solicitor-General, (Chairman.)
Mr. J. J. McLeod.
,, H. E. Murray.
,, W. Greig.
(Mr. A. E. Collens, Secretary).

A draft of Ordinance relating to Bush Fires was submitted to the Board for their opinion in regard to Clause 8 relating to burning of cultivated plants for protection of disease. The Solicitor-General was asked to draft an amended clause and further consideration of the matter was postponed to the next meeting.

Tobago Farm.

The report of the Tobago Farm Committee was presented, and on the motion of the Hon. Mr. S. Henderson, seconded by Mr. J. D'Abadie, was adopted.

Assistant to Honorary Secretary.

At the request of the Secretary the appointment of Mr. J. Pinder at a salary of $30 per *mensem*, as an assistant to him in laboratory and office was confirmed, and he was further authorized to pay travelling expenses and allowance to this official.

Vote for Exhibits and Posters.

A sum of $200 was voted by the Board for the purpose of preparing exhibits for local Agricultural Shows, with a view to instruct as to the best methods of detecting and treating diseased plants, &c.

Mr. J. J. McLeod suggested that diagrams and instructions should be prepared and placed at Police Stations and other places where public notices were posted for information in outstations, and the Board approved of this suggestion, and instructed the Secretary to arrange for such posters.

Agricultural Tax.

The Committee appointed by His Excellency the Governor to consider the rates of the Agricultural Tax for 1910 reported to the Board and their recommendations were approved with the exception

of the tax upon rubber which, after discussion it was agreed for the present to leave untaxed.

The Secretary read a letter from Mr. H. R. Hamilton, Secretary of the Tobago Planters' Association, asking that the travelling expenses of Mr. Thos. Thornton, who represents Tobago on the Board, decided to bear the expense of the steamer fare, on the occasions of Mr. Thornton attending their meetings. Tobago representative.

The Honorary Secretary reported that he had received a letter from the Director of Agriculture, Federated Malay States, dated 30th September, in which the latter informed him that he hoped to make the first shipment of seed 100,000, a week after writing. The orders for stumps amounted to some 650,000, and the Secretary reported that Government had sanctioned the ordering of a second 500,000, making one million seeds in all. Hevea seed from Malaya.

J. B. Carruthers,
Honorary Secretary.

At a meeting of the Board of Agriculture held in the Council Chamber, on Friday, 21st January, 1910.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (President) *in the chair.*
The DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon. Mr. G. T. FENWICK, C.M.G.
,, ,, ,, S. HENDERSON.
,, ,, ,, C. DE VERTEUIL.
,, ,, ,, R. S. A. WARNER, K.C.
,, ,, ,, W. KAY.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. J. D'ABADIE.
,, L. SEHEULT, B.Sc.
,, L. DE VERTEUIL.
,, J. MOODIE.
,, H. E. MURRAY.
,, E. L. SELLIER.
,, T. THORNTON.
,, J. H. WADE.
,, J. J. McLEOD.
THE ASSISTANT DIRECTOR OF AGRICULTURE (Hon. Sec).
,, MYCOLOGIST.
,, ENTOMOLOGIST.
,, CURATOR OF GARDENS.
,, ACTING MANAGER, GOVERNMENT FARM.

The minutes of the previous meeting after an alteration to the figures in the last financial statement were confirmed.

The monthly financial statement was submitted :—

Balance in Bank November 30th, 1909 ...	$10,922 85
Agricultural Tax for November ...	987 06
	$11,909 91
Payment during December	980 01
	$10,929 90

The Mycologist, Mr. J. B. Rorer reported as follows :—

"Since my last report another picking has been made from the cocoa spraying experiment plots at Guanapo and the results are still better than those reported at the last meeting of the Board. Three pickings have been made from the plots; the results of the two earlier ones were reported last time, and though there was not a very noticeable increase in number of pods from the sprayed trees as compared with the unsprayed there was a very marked increase in the number of sound pods. That is to say the chief effect of the spraying was reducing the percentage of black cocoa. In the picking

which was made last Friday there was not only the same perceptible reduction of black cocoa but there was a marked increase in the number of pods gathered from the sprayed trees. While 1,159 pods were gathered from the control trees 1,843 were picked from the sprayed trees and in addition there was a gain in sound pods as well. Only 7 per cent. of the fruit was black from the sprayed trees and 23 per cent. from the control trees. This gave 882 more sound pods from the sprayed plot.

The increase in number of pods at this picking shows that the spraying saved the pods when quite small, as the spraying was done 115 and 130 days before the picking. Taking Mr. de Verteuil's figure of 142 days as the life of a pod it will be seen that these fruits which were picked last Friday were from ½ to 2 inches long at the time when the spraying were made.

In the three pickings which have been made since the experiment was started, the sprayed trees have given 1,580 more sound pods than the unsprayed trees, and a total of 799 pods more. This gain has given 360 lbs. of sound wet cocoa.

As directed by the Board at its last meeting a paper has been prepared for the next issue of the Bulletin, embodying the results from this experiment and giving directions for preparing Bordeaux mixture, the fungicide used in this work.

The work of destroying dead and diseased coconut palms for which the sum of $500 was voted at the November meeting was given over to Mr. Plummer who has pushed it forward quite rapidly and tactfully as well. This work was started at the eastern end of the Laventille district. All dead trees have been cut down and cut into sections suitable for burning, while all dying trees in which the terminal leaf was affected have been cut down and buried either wholly or in part. The work of felling and burying trees at Laventille was finished on January 8th; since that time the men have been working about Four Roads and Diego Martin. The burning of the trees will be started on Monday. If this work can be carried out all over the island, there is no doubt that it will do a great amount of good, but it must be backed up by an Ordinance, making it compulsory for proprietors to keep their places clean afterwards.

If this is not done the work will be productive of much less good. At Laventille for example many trees are affected with bud-rot but the terminal leaf has not yet died so we could not cut them down at present. These trees will die within the next few months. Sound trees will be infected from them and eventually the whole place will go back into the same condition that it was in a few months ago. A good working Ordinance is needed which will make it unlawful for a man to let dying coconut palm trees exist on his property. Such an Ordinance is essential to the welfare of the coconut industry here.

In answer to questions addressed to him by Mr. C. de Verteuil and Mr. Seheult, Mr. Rorer said that the two plots of 500 trees each on which the cocoa experiment was made were practically equal in all ways. The soil, drainage, shade and cultivation was the same for each so that the difference in yield could be attributed to the spraying without much doubt. Though it was impossible to keep an exact record of the cost of this spraying it was roughly about ¾ of a cent

per tree, per application. This should not be taken as a criterion however an experiment being always relatively more costly than larger operations.

In reply to Mr. Murray, Mr. Rorer said he thought there was no danger of disease spreading from the buried coconut palms.

The Entomologist presented his Report on the work done in connection with "Froghoppers" during the past year, confined chiefly to field operations, but including experiments with insecticides and observations made in connection with the distribution, seasonal occurrence and food plants of the "Froghopper." The insects establish themselves very early in the year on grass in the fields of young plant canes. They seem to live on grass as well as on canes, they are numerous on grass in the traces through estates and a great many tided over the dry season in these places. In the cane fields "Hoppers" are very fond of going under the so-called "boucans" where they find protection and food on the young grass roots. No period of rest has been observed. Insects were present during the whole year, but in the rainy months (July–September) they are more numerous. In order to establish the relations of "Froghoppers" to blight, two experimental cages were put up respectively at Caroni and Couva and kept free from "Froghoppers" it was expected that those particular fields would be attacked by blight, but it so happened that in neither place was any blight observed. In the Caroni district a few "Froghoppers" were present on the canes outside the cage but no change took place in the canes neither outside or inside the cage. Adults came readily to light and could be trapped by lanterns. Nymphs can be killed by Kerosine emulsion. The best time to spray is the dry season when they were few insects present and the canes removed from the fields. Keeping the fields clear of grass also prevents an increase of insects and during the dry season all abandoned fields and the traces should be burnt off. Fields of young plant canes should be specially watched and kept free of "hoppers" from the very start. Boucans on fields affected or likely to be affected should always be avoided. Trap lanterns are useful to locate insects in the fields. The biological part of the work to be done, *i.e.*, the working out of the complete life history of the insect requires very close observation, and this would be further investigated during the coming year. With regard to *Thrips* in Cacao at Guaico, it was reported to him that the insects had been controlled by spraying and their increase stopped.

Mr. H. E. Murray moved, and Hon. Mr. S. Henderson seconded:—

> "Considering the imperative necessity of obtaining accurate knowledge as to the Froghopper pest and discovering effective preventives and remedies, the Entomologist shall be requested to devote himself entirely to this matter for the present."

After discussion in which a proposal of sending out an Entomologist from England to work with Mr. Urich was mentioned, and it was also suggested that the temporary services of a local Entomologist, Mr. Guppy, in the Government service might be asked for. The motion was put and carried by 14 votes to 3. His Excellency informed the Board that, in the case of such an arrangement as had been suggested of seconding a Government Officer to help Mr. Urich being arranged,

the Board would have to pay the salary of the gentleman in question.

A letter from the Colonial Secretary was read by the Secretary, in which the Board was informed that the Government did not consider it advisable to extend the provisions of the Sale of Produce Ordinance to Sugar. The Hon. the Solicitor-General explained the views of Government to the Board and stated that the Ordinance would be altered to exclude coconuts.

A letter was read from the Secretary of the Canadian Trade Commission enclosing a series of questions upon which the Committee wished the views of the Board. It was decided to refer the matter to a Committee consisting of the Vice-President Hon'bles Messrs. Carl de Verteuil and S. Henderson and Mr. J. Moodie.

The Vice-President asked for a grant from the Board to allow him to give prizes for cattle at the proposed Cattle show to be held at the Government Farm. The clause of the Ordinance regulating the disposal of the Board's funds did not allow of such a grant and it was agreed to apply to Government for an alteration of the wording of the clause so as to allow of this and similar grants.

The Vice-President submitted a suggestion of the Acting Manager Government Farm recommending Government to legislate so as to prevent the export of animals bred at the Government Stock Farm. After discussion on the motion of Hon. the Solicitor-General, who saw some difficulties in such legislation, the matter was postponed for further information.

The Vice-President laid before the Board the report of the Acting Manager, Government Farm, in regard to the changes at the Tobago Stock Farm, and the Board referred the matter to the Committee which they had appointed to report on the Tobago Stock Farm.

On the motion of the Honourable the Solicitor-General seconded by the Hon. Carl de Verteuil, the Board recommended that the draft of the Agricultural Fire Ordinance which had been referred by the Legislative Council for the consideration of the Board should be amended by deleting Section 5 and enacting the following Section to follow Section 22 :—

> "Nothing in this Ordinance contained shall apply to setting "fire to land for the purpose of eradicating or preventing "the dissemination of any disease within the meaning of "the Agricultural Protecting Ordinance No. 127, or any "Ordinance amending the same or extending the pro-"visions thereof."

The following report of the Committee appointed by the Board at their last meeting to consider draft of an Ordinance relating to a disease called Ankylostomiasis was read and on the motion of the Hon. Solicitor-General, seconded by Hon. Mr. S. Henderson, was adopted by the Board :—

Report of Committee on Ankylostomiasis.

3RD JANUARY, 1910.

A meeting of the Committee appointed by the Board to consider the draft Ordinance on Ankylostomiasis was held in the Board's Office, on Monday, 3rd January, at 2 p.m.

The Chairman explained that of the two recommendations of the Committee of the Legislative Council to whom the order was referred, and who reported on the 1st June, 1909 (No. 33), the recommendation that every building used as a human habitation and in human occupation throughout the Colony should be provided with sufficient and suitable privy accommodation had been adopted, and provision made therefor in the New Public Health Ordinance about to be ntroduced into the Legislative Council.

In view of this explanation the Committee do not consider it advisable to make the provision of similar accommodation for the use of persons employed in factories and subject to a separate Ordinance, and recommend that the necessary legislation be nserted in the Public Health Ordinance.

The Committee are strongly of opinion that the enforcing of the Ordinance should be the duty of the Public Health Authorities. To impose such a duty on the Employers of Immigrants would cause friction between the Estate authorities and their labourers, and tend to disturb the relations that should exist between them.

The Committee suggest that prophylatic and remedial treatment should be begun as early as possible, viz :—

(1.) At the Depôts at Calcutta and should be continued on the outward voyage and

(2.) At the Depôt here before the immigrants are distributed to the various estates

(Signed) AUCHER WARNER, Chairman.
H. E. MURRAY.
J. J. MCLEOD.
WILLIAM GREIG.

Colonel Collens, V.D. asked a question as to the position of Mr. A. E. Collens who was appointed at the first meeting as Scientific Assistant and Secretary to the Board *pro tem.* The discussion of the matter was postponed to a further meeting, Colonel Collens giving notice of repeating his question.

The Board adjourned at 4.15.

J. B. CARRUTHERS,
Honorary Secretary.

28th January, 1910.

At a Special meeting of the Board of Agriculture held in the Council Chamber on Monday 31st January, 1910.

PRESENT :

HIS EXCELLENCY THE GOVERNOR (President) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (Vice-President.)
THE HON. MR. G. T. FENWICK, C.M.G.
,, ,, ,, S. HENDERSON.
,, ,, ,, W. G. KAY.
,, ,, ,, C. de VERTEUIL.
,, ,, ,, R. S. A. WARNER, K.C.
LIEUT.-COLONEL J. H. COLLENS, V.D.
MR. J. D'ABADIE.
,, L. de VERTEUIL.
,, W. GREIG.
,, J. MOODIE.
,, L. SEHEULT, B. SC.
,, E. L. SELLIER.
,, C. W. HAYNES.
GOVERNMENT BOTANIST AND ASST. DIRECTOR OF AGRICULTURE, (HON. SECRETARY).
THE MYCOLOGIST.
,, ENTOMOLOGIST.
,, CURATOR OF GARDENS.

His Excellency the Governor read to the Board the following telegraphic despatch which he had received from the Secretary of State :—

> "Following Sugar companies New Colonial, Tennants, Trinidad Estates, Kleinwort, Alston represent increasing ravages Froghopper source of much anxiety to all concerned and that as Carruthers not in position to render assistance required it is absolutely necessary that expert Entomologist should be sent immediately to investigate matter fully. Companies are endeavouring to find suitable man and they express hope that their contribution to upkeep of Agricultural Department will be available to meet expenditure. Will be glad if you would in consultation with Board of Agriculture, consider question of making substantial contribution from Board's funds towards expenditure, at present roughly estimated at twelve hundred pounds (£1,200) or more.
>
> Telegraph reply please."

Apologies for absence were read from Messrs. H. E. Murray, J. J. McLeod and J. P. Bain.

After a discussion in which the Director of Agriculture Hon. Messrs. C. de Verteuil, S. Henderson, R. S. A. Warner, the Entomologist and the Hon. Secretary to the Board took part and in which the latter proposed that the Board should proceed at once to carry out experiments on areas of considerable size to prove the value of the curative and preventive means already discovered.

The Hon. Mr. S. Henderson moved and Hon. Mr. W. G. Kay seconded:

> "That this Board agrees to contribute for the purpose of the Sugar proprietors in London connected with this Island sending out a scientific expert to deal with Froghoppers."

An amendment was moved by Hon. Mr. Carl de Verteuil and seconded by Mr. Scheult.

> "The Board having devoted the services of its own Entomologist to the study of the Froghopper and being ready to contribute liberally for the purpose is not prepared to contribute towards the expenses of the expert proposed to be sent out."

The amendment was carried by 9 votes to 6.

The Secretary read a letter from the Director of Education agreeing to the proposal that Mr. P. L. Guppy of his Department should be seconded for Entomological work for three months and the Board agreed to appoint Mr. Guppy at a salary of £25 *per mensem*.

J. B. Carruthers,
Hon. Sec., Board of Agriculture.

At a meeting of the Board of Agriculture held in the Council Chamber on Friday, 25th February, 1910.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (President) *in the Chair*.
THE DIRECTOR OF AGRICULTURE (Vice-President).
THE HON'BLE MR. C. DE VERTEUIL.
,, ,, ,, G. T. FENWICK, C.M.G.
,, ,, ,, S. HENDERSON.
,, ,, ,, W. G. KAY.
,, ,, ,, R. S. A. WARNER, K.C.
MR. J. P. BAIN.
Lieut.-Colonel J. H. COLLENS, V. D.
MR. J. D'ABADIE.
,, L. de VERTEUIL.
,, J. J. McLEOD.
,, J. MOODIE.
,, L. SEHEULT, B. SC.
,, J. H. WADE.
THE ASST. DIRECTOR OF AGRICULTURE (HON. SEC.)
,, MYCOLOGIST, MR. J. B. RORER, M.A.
,, ENTOMOLOGIST, MR. F. W. URICH, F.E.S.
,, ASSISTANT ENTOMOLOGIST, MR. P. L. GUPPY.
,, CURATOR OF GARDENS, MR. F. EVANS.

The Minutes of the meeting on January 21st and Special meeting on January 31st were confirmed after an alteration proposed by Hon'ble the Solicitor-General: that the third paragraph from the end of the minutes of the meeting of January 21st should read as follows :—

On the motion of the Honourable the Solicitor-General seconded by the Honourable Carl de Verteuil, the Board recommend that the draft of the Agricultural Fire Ordinance which had been referred by the Legislative Council for the consideration of the Board should be amended by deleting Section 5 and enacting the following section to follow Section 22 :—

"Nothing in this Ordinance contained shall apply to setting fire to land for the purpose of eradicating or preventing the dissemination of any disease within the meaning of the Agricultural Protection Ordinance number 127 or any Ordinance amending the same or extending the provisions thereof."

The monthly financial statement was submitted :—

Balance as per previous financial statement	$ 10,929 90
To Agricultural Tax for December ...	1,388 62
	$ 12,318 52
By Payments during January... ...	1,204 56
Balance January 31st	$ 11,113 96

The Mycologist reported that his branch of the Board's work was progressing satisfactorily and that he had compiled a record of the cacao spraying experiments and of the coconut disease preventive work which were in the hands of the printer and would be issued in the forthcoming number of the Bulletin.

The Entomologist reported that Mr. P. L. Guppy assumed his duties as Assistant Entomologist on February 1st and had made a tour through Tobago where his services were required. He (Mr. Urich) had been engaged in planning and arranging for the experiments in regard to Froghopper the details of which would be laid before the Board when this item on the agenda was reached. He also submitted a proof of his paper giving an exhaustive account of the work on the Froghopper pest which would be published in the Bulletin.

The Board went into Committee to discuss rules for the carrying on of the work of the Board and its officers which had been prepared by the Advisory Committee.

On resuming the Board adopted the following rules, the Director of Agriculture dissenting :—

1. The offices of the Board to be at St. Clair.
2. The Assistant Director of Agriculture shall be the Chief Executive Officer of the Board and shall be in charge of the Board's Laboratories, supervise the work of the Officials of the Board and arrange for their reports of progress.
3. The Secretary shall be responsible for all books and papers and other property of the Board.

   The Director of Agriculture wished his dissent from the Assistant Director performing the whole duties of Secretary recorded.
4. The Secretary shall deal with the correspondence of the Board. Answers to letters since the last meeting shall be laid on the table for inspection of members. Any correspondence of sufficient interest shall be separately reported to the Board.
5. The Secretary shall keep the Accounts of the Board and pay out all monies expended on the Board's work. All monies expended to be supported by vouchers with the exception of sums not exceeding $1 which may be supported by a verification of the Secretary without the previous consent of the Board. Sums under $25 may be disbursed by the Secretary without the previous consent of the Board, such sums to be reported and passed by the Board at their next meeting.

   The monies voted by the Board to be placed in the Bank to their account and operated on as directed.

   All cheques shall be signed by the Secretary and such Member or Members of the Board as may be appointed by resolution of the Board for that purpose (*See* Ordinance No. 35—1908, Section 5 (5).

A monthly statement shall be laid on the table showing :—

Balance in Bank 30th ultimo.
Agricultural Tax for last month.
Expenditure during last month.
Balance,

and a similar statement for the money voted under separate heads and not expended :—

Laboratory—$1,500.
Balance to credit 1st of month.
Expenditure during last month.
Balance.
Rubber Curing house—$1,000.
Balance to credit 1st of month.
Expenditure during last month.
Balance.

The Board agreed that Mr. A. E. Collens' appointment as Secretary and Scientific Assistant should terminate on 28th February.

The resolution of the Board of 27th November, 1908, that cheques were to be signed by the Director of Agriculture was cancelled at the Director's request.

The Secretary asked that sanction might be given for expenditure in connection with the field experiments on "Froghopper" in order that there might be no delay and the Board agreed to such expenditure up to $300.

The Secretary in view of the amount of business on the agenda which had not been dealt with asked for an adjournment to Friday March 11th, and the hour of 1·45 was fixed as more convenient than 2 o'clock.

J. B. Carruthers,
Honorary Secretary.

28th February, 1910.

Bulletin of Department of Agriculture, Trinidad.

VOL. IX. JULY, 1910. No. 65.

Pod-Rot, Canker, and Chupon-Wilt of Cacao caused by Phytophthora sp.

BY

JAMES BIRCH RORER.

INTRODUCTION.

THE three diseases discussed in this paper are met with on almost every cacao estate in Trinidad, and the first two have been reported from practically all countries in which cacao is grown commercially. The annual loss caused by these diseases cannot be accurately estimated. On some of the old estates many trees are so badly cankered that they are practically worthless, while an examination of the heaps of pods picked in the rainy season on the majority of estates shows that from 30 per cent. to 60 per cent. of the fruits are rotted. Then too many young pods are killed before they reach maturity so that they are not even gathered. The chupon-wilt was especially severe last year and many of the suckers left for renews were killed back and had to be removed.

Heretofore the relation of pod-rot to canker has never been clearly understood and the cause of each has been attributed to a number of different fungi, but cultural and inoculation experiments which have been carried on during the past eight months point to the fact that they are both caused by the same fungus. This is a species of Phytophthora which in 1899 was identified as *P. omnivora*, a well known parasite, but a careful examination shows that it is different from that species in some respects as will be pointed out farther on in this paper.

The chupon-wilt is described here for the first time.

HISTORY OF POD-ROT AND CANKER.

From the wide distribution of pod-rot and canker it is evident that these diseases have been prevalent in cacao growing countries for many years, so that their origin cannot be traced. They were reported almost simultaneously from the East and the West, but only after the yield had already been appreciably diminished on account of their ravages.

Perhaps the first reference to canker is that of Porter[1]* in his book on tropical agriculture published in 1833 in which he says: "Cacao trees are subject to a disease which shows itself in the form of black spots, or blotches, on the bark, and which as soon as they appear should be carefully cut out or the tree will quickly die. This disease does not make its appearance until the trees are in a bearing state."

Another early reference to a cacao disease which may have been the Phytophthora pod-rot, is that of Dr. de Verteuil[2] in his book on Trinidad. He says: "In the year 1727, however, a terrible epidemic spread in the cacao plantations of Trinidad. The trees were apparently healthy and vigorous; the flowering abundant, giving fruits, but none of them came to maturity, as the young pods dried up before full growth." As a result of this outbreak the commerce of the Island was crippled and the cacao industry was not revived until 30 years later when the Capuchin Fathers imported the Forastero cacao from the mainland which was used to a great extent to replace the Criollo, the variety previously cultivated.

It is only within the last fifteen years however, that careful descriptions of the diseases have been given, curiously enough that of pod-rot coming from the West and that of canker from the East.

Harrison in 1895[3] reported a disease from Grenada, and described it in such a way as to leave little doubt that it was the Phytophthora pod-rot, and in 1897[4] he found that the same disease was quite common in Suriname and present to a slight extent in British Guiana. By transferring spores from the surface of affected pods to healthy pods he reproduced the disease, thereby showing its infectious nature. The remedial measures suggested were the destruction of the husks from diseased pods and the spraying of the trees with Bordeaux mixture.

At about the same time the serious nature of cacao canker was first brought to general attention because of a serious outbreak of the disease in the Matele district of Ceylon. During the early part of 1897, various letters discussing the outbreak and giving theories as to the cause of the disease appeared in the *Tropical Agriculturist* and the newspapers of Ceylon, but the first detailed description of the disease under the name of cacao canker was given by Willis and Green.[5]

These authors made a tour of the cacao districts of Ceylon and found the disease widespread. Experienced planters stated that they had observed it for at least 20 years and that it had become quite prevalent since 1892 or 1893.

Canker was found to be largely confined to the "old red" cacao (a Criollo type), while Forastero was but slightly attacked.

The disease was recognised in its earliest stages by a darkening of the surface of the bark, and as it became more pronounced a pinkish gummy matter exuded from the diseased area. The tissues beneath these diseased patches of bark were of a claret red or brownish colour, and were separated from the normal whitish or yellowish tissue by a definite cork cambium layer, visible as a dark narrow line. It was found that vigorous growing trees when attacked

* The numbers refer to the Bibliography which will be found at the end of the paper.

might throw off the diseased patches by new growth from below, but most commonly, however, the disease worked into the cambium layer which became brown and decayed. As a rule trees in a weak condition were more frequently attacked than vigorously growing ones.

A branch immediately above a diseased patch usually died while frequently the whole top of a tree withered up as a result of the girdling of the trunk by the disease. The young branches and roots however never seemed to be attacked.

From the general character of the disease and the fact that it spread chiefly during the wet season, the authors concluded that it was of fungous origin, though no definite parasite was found in the diseased parts.

They suggested that the disease might be held in check in two ways, namely by putting the trees in better condition to withstand fungus attack by drainage and a reduction of shade and by the exercise of more care in pruning and digging out borers so as not to leave large open wounds as points of infection, and by cutting out and burning the diseased tissue, but if a stem was badly affected the advice given was to cut down and burn the whole tree and supply with Forastero.

Soon after beginning work on the disease, Willis sent material from diseased trees to Kew for examination, and asked that a specialist be sent to Ceylon to study the disease. The report upon this material by Morris and Massee together with a further note on the disease by Willis was published later in 1897. [6]

In his memorandum to Willis, Morris took for granted that the disease was one of the roots and suggested as a remedy that the estates be better drained, the shade thinned out and the soil thoroughly forked and well limed in areas where trees had died, and that healthy trees should be isolated by deep trenches and given only the amount of shade absolutely necessary.

In an examination of the material sent from Ceylon, Massee found the mycelium of a basidiomycetous fungus in the tissues and from this concluded that the disease was one of the roots rather than of the stem. He seconded Morris' remedial suggestions and in addition emphasized the necessity of digging out the roots of dead trees and sterilizing the soil by fire.

The Director of the Royal Gardens, Kew, considering that these reports left little room for doubt as to the cause of the disease thought it unnecessary that a specialist be sent out.

In his comment on the reports of Morris and Massee, Willis stated that the observations made in the field contradicted the root disease supposition, and further that, since the previous report, reproductive organs of a fungus apparently the cause of the canker had been found on the bark of diseased trees.

These organs were not found on the roots. This fungus was not identified however, but simply the statement made that it belonged to the group of fungi causing many of the bark cankers.

The recommendations given in the previous circular were repeated with the added suggestion that all diseased trees and the stems of shade trees should be sprayed with Bordeaux or lime sulphur mixture, and that it would be better perhaps not to remove the

suckers from trees on estates where the disease was bad, as the wounds offered openings for the fungus to attack the trees.

Through the action of the Ceylon Planters' Association, Carruthers went from England to Ceylon and undertook a study of the disease, devoting the whole of the year 1898 to this work. His results were published in three reports, [7], [8], and [9].

In the first report [7] Carruthers concluded that the disease was of fungous origin and attacked only the stem of the tree. He found septate fungous hyphæ in the affected tissues of the bark, and sporophores, which he considered to belong to the same fungus, on the surface of the diseased areas. Two types of spores were found, small oval, and long crescent shaped ones usually 8-septate.*

To prove that this fungus was the cause of the disease he made a number of inoculations on 5 to 7 year old healthy cacao trees, using bits of diseased tissue and spores of both types taken with a paint brush directly from the sporophores found on diseased bark. Slanting cuts were made through the bark into the wood and the inoculating material put into this wound which was then bound up firmly, and wrapped with wet paddy straw to keep the inoculated areas moist.

Ten inoculations were made with bits of diseased bark, thirteen with the microconidia and six with the macroconidia while two cuts were made and wrapped with moist straw as controls. The results of the inoculations were given in a table.

The inoculations made with the bits of diseased tissues were the most successful as the disease was produced in seven cases within two or three weeks time. Four of the thirteen inoculations made with the small primary spores (microconidia) were considered successful, but none showed symptoms of disease until after the third week and two remained doubtful until the sixth week.

Only one of the inoculations made with the septate spores (macroconidia) was successful, and in this case no signs of disease were observed until after six weeks time.

The remedial measures suggested were practically the same as those given by Willis and Green in their first report namely to cut out the cankered areas and reduce the shade to the minimum necessary amount.

In this report Carruthers called attention to the serious nature of the pod-rot and ascribed it to a peronsporaceous fungus. He estimated that 50 per cent. of the crop in Ceylon was annually destroyed or rendered of inferior value by this disease. He inoculated a number of healthy pods by inserting in cuts bits of diseased pods and in every case the disease was quickly induced and the pods were entirely rotted within 8 or 10 days.

Carruthers in his second report [8] gave a detailed description of the canker disease and its effect upon the tree, the life history of the supposed causative fungus, and the methods of treatment, which after a series of various experiments, gave the best results. In addition to the two tpyes of spores mentioned in the first report, the perfect stage of the fungus in the form of small crimson spherical bodies

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*These were evidently the micro- and marco-conidia of a Fusarium though no name was given to the fungus.

containing asci and spores was found on diseased bark so that the life cycle of the fungus was completed.

Further it was found that no special predisposition of the trees was necessary for the attack of the fungus, the only conditions necessary being the moisture and heat requirements of the fungus.

The remedial measures as given in the first report were found to be successful, but the necessity of burning all diseased parts removed was further emphasized.

The remedial measures found to be of value were :—

1. To excise all diseased tissue, being careful to cut out beyond the discoloration. In cases where a tree was very badly affected the bark might simply be shaved, but this method was only to be resorted to in cases where the entire removal of the diseased tissue would likely prove fatal to the tree.
2. To burn all diseased parts so removed.

A canker was also found in the thorny Bois (*Erythrina umbrosa*) which was considered to be the same as the cacao canker because the latter could be produced by inoculations with diseased tissues and spores from the Erythrina.

Further notes on the pod-rot were also given in this report and as a remedial measure the suggestion was made to pick and burn all pods as soon as affected.

After the publication of these two reports on canker and pod-rot several Ceylon planters called attention to the fact that in many cases the bark of the tree around the cushions bearing diseased pods was cankered, and asked if there was not some relationship between the pod and the stem disease.

In his third report [9] Carruthers took up this question. Examinations led him to believe that undoubtedly there was a connection between the canker in the bark and the diseased pods. In his earlier examinations he had overlooked the fact that in addition to the spores and mycelium of the peronosporaceous fungus the mycelium and conidia spores of the canker fungus were also present on the diseased pods. In order to show the action of the canker fungus on pods he carried out the following experiments :—

" (*a.*) Pieces of cankered bark were placed in selected healthy pods on sound trees. Five pods were so treated. In all cases the pods became diseased after about eight days, and in less than fourteen days spores of both fungi were produced in abundance.

(*b.*) Pieces of diseased pods were placed in the bark of sound trees. Eight of these experiments were made. In all cases canker was produced in the bark after about ten days.

(*c.*) Pieces of cankered bark were placed in the bark of sound trees just above the stalks of healthy pods. Seven of these experiments were made. In all cases the pods became diseased, and on them were produced the spores of both fungi in about eight days, and on their stalks the spores of the canker fungus only.

(*d.*) Pieces of diseased pods were placed in healthy pods on sound trees, and the disease having been produced, the

effect on the adjoining bark was observed. Six of these experiments were made. In three of these experiments the canker was produced in the bark of the tree adjacent to the stalk, and in the other three cases the stalk of the pod was cankered, but not the adjacent bark; in one of them the canker went into the wood of the tree through the stalk, but without affecting the bark surrounding the stalk."

From these experiments the following conclusions were drawn :—

"1st. That the canker fungus can spread from the bark to the pods.

2nd. That the canker fungus can spread from the pod to the bark.

3rd. That the pod disease before described (in the first report) affecting the pod does not grow in the bark and is confined to the pod tissues not running into the stalk of the pods."

Further, Carruthers also stated that the experiments showed that the canker fungus grew much more rapidly in the pod tissue than in the bark and produced its spores much sooner on the former than on the latter. "On the bark it takes weeks and often months for the spores to form; on the pods, it is a matter of days. The prompt appearance of the Peronospora fungus after the canker has affected the pods is shown by experiment (c); but the exact share which these two fungi take in the destruction of the pod tissues should be made the subject of further experiments and observation."

An examination of some hundreds of diseased pods showed that the two fungi were in every case found associated; as the probable explanation of this it was suggested that the Peronospora fungus belonging to a group most of which are parasitic, but which also has some members which are saprophytic, at once succeeded the canker fungus and lived on the tissue killed by it. He was not able to prove this on account of the difficulty in isolating the Peronospora spores *alone* on a healthy pod. "The action of the canker spores alone was observed on a healthy pod, but in the space of about two hours they were joined by the Peronospora fungus and spores of this latter produced."

As a result of this activity in the East the subject of cacao diseases was brought before the Agricultural Society of Trinidad for attention during the year 1898. Specimens of diseased pods were submitted to Hart who reported [10] that after a careful and lengthy microscopical study he was unable to say that the pods had been destroyed by disease, but advised that a strict watch be kept for anything which appeared to be of a pernicious character.

More specimens of diseased pods were submitted to the Society a little later and early in 1899 a committee was formed for the purpose of finding out the nature of this disease and its prevalence in Trinidad.

The report of the committee [11] was as follows :—

1. The malady was due to a fungus. (Specimens had been sent to Kew for identification).
2. Experienced planters had known the disease for at least twenty-five years.

3. There was no evidence to show that the cacao tree itself was in any way affected by the disease of the pods.
4. Experiments made by the Government Botanist showed that the disease could be transmitted from one pod to another by inoculation.
5. The disease was more common near the breaking places than in other parts of estates.

To combat the disease it was recommended to cover all refuse with soil and bury it and to collect and destroy all pods which showed signs of the disease. In conclusion the Committee thought that the importance of the disease in Trinidad had been over-estimated.

Massee [12] reported on the material which had been sent to Kew for examination. He identified the fungus causing the trouble as *Phytophthora omnivora* De B., and found that the oospores were formed in the pod tissues. He also found on the surface of the diseased pods another fungus which he named *Nectria bainii* and suggested that this fungus might possibly attack the trunk of the tree.

Hart [13 14] was the first to make pure cultures of this Phytophthora and with them to reproduce the disease by inoculation.

A disease of the cacao tree itself similar to the canker in Ceylon was evidently first noted in the West Indies during the year 1899. Specimens were sent to the Trinidad Botanical Department by a planter and were then forwarded to Kew for examination. On this material Massee [15] found a Fusarium and a Nectria and stated that the symptoms of the disease appeared to be identical with those of the canker disease of Ceylon, but he could not say whether the species of Nectria associated with the diseases in the West and East respectively were the same, as that from Ceylon had not yet been described in detail.

It was not until the latter part of 1900 that Carruthers [16] named the fungus which he had found associated with the Ceylon canker. He considered it to be *Nectria ditissima* Tul.

On returning to Ceylon in 1901 Carruthers [17] again took up the study of canker and pod-rot. His conclusions at this time were much the same as those previously reported. He considered that Nectria was the cause of the pod disease, and the associated Phytophthora a mere concomitant. At this time the canker had much decreased since 1898 owing to the means having been taken to combat it, and the fact that no season specially favourable to the fungus had occurred.

Howard [18] made the first full report on cacao diseases in the West Indies. He found that canker was quite common in several of the islands, but that the Phytophthora pod-rot was rarely met with outside of Trinidad. He considered that the serious pod disease which he found in Grenada, St. Lucia, St. Vincent and Dominica, was caused by *Diplodia cacaoicola* P. Henn.

In connection with the canker he found two distinct fungi on the diseased areas, sometimes one alone, at other times the two together. Specimens of these fungi were sent to Massee who regarded them as new

species to which he gave the names *Nectria theobromæ* and *Calonectria flavida*.*

Howard made preliminary infection experiments by introducing ripe ascospores of each fungus (taken evidently from perithecia on diseased bark) into wounds in cacao trees; distinct infections were produced but the author stated that the matter needed much further investigation.

In 1904 Hemple [19] reported a new species of fungus, *Calonectria bahiensis* as the cause of canker in Brazil but made no inoculations with pure cultures.

Busse [20] who visited the cacao plantation in the Cameroons reported the pod-rot caused by Phytophthora as the most serious disease met with there, and for the first time recorded the occurrence of this fungus on the bark of the cacao tree, but gave no account of canker.

Lewton-Brain [21] and Stockdale [22] [28] have both within recent years reported on cacao diseases in the West Indies, but have added nothing new in regard to either canker or pod-rot.

Petch [23] in Ceylon was the first to question the parasitism of the various Nectrias and Calonectrias to which cacao canker has been ascribed in various countries. In his report he summarises the condition in Ceylon as follows:—

"(1.) A disease attacking the pod may work through the peduncle into the stem.

(2.) The stem may become diseased quite independently of any pod disease.

(3.) The first fact has led to the belief that the stem and pod diseases are identical, both being due to a Nectria.

(4.) The fungi on diseased pods are Phytophthora sp. and *Collectotrichum incarnatum* always; rarely a Diplodia, and a Dialonectria not identical with any species enumerated above. This Nectria also occurs on Panex killed by Rosellinia.

(5.) The Nectria on the stem is not the same as the Nectria on the pods. The former agrees with *Nectria striatospora* Zimm. It is perhaps the commonest Ceylon Nectria, and has been found on tea killed by *Massaria theicola*, tea with branch canker, felled Albizzia, dead *Derris dalbergioides*, &c.

There are numerous examples collected by Thwaites in the Herbarium, but they have been named by Berkeley either *N. cinnabarina* or *N. sanguinea*.

(6.) If a pod is left until the disease extends through the peduncle to the bark (only a matter of one or two days), and the top of the pod, the peduncle and the surrounding bark are then cut off separately and placed in sterile chambers, Phytophthora sporangia form on all three. I have not, however, been able to obtain Phytophthora from bark in which canker has risen independently of the pod disease.

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* *N. theobromæ* was described in Bulletin Miscellaneous Information Royal Gardens, Kew, No. 5. p. 216, 1908, but so far as the writer knows *C. flavida* has not yet been described. The spore measurements are given by Howard.

(7.) If the stem and pod diseases are the same, they cannot be due to Nectria. That both can be caused by Phytophthora seems at present improbable. In the initial stages of stem canker it is often impossible to find any hyphæ in the diseased bark; bacteria have been found in the cases in which they have been looked for, and it seems probable that the cause of both cacao Canker and Hevea canker must be sought in this direction."

Barrett during the latter half of the year 1907 visited Trinidad for the purpose of studying plant diseases. The results of his investigations in regard to cacao troubles were given in several reports [24, 25, 26 and 27]. He estimated that from 50 to 75 per cent. of the cacao fruits were destroyed by fungous pests and 90 per cent. of this damage he estimated was due to a species of Lasiodiplodia. He found Phytophthora spores on pods but did not consider it responsible for much damage.

He considered Lasiodiplodia the chief cause of canker, but suggested also that two or three species of Nectria, as well as Phytophthora, might gain an entrance into the bark and wood through wounds.

Although Busse did not observe canker in the Cameroons in 1903, Von Faber [29] later reported it as prevalent there. He found a species of Nectria in connection with it. He made no inoculation experiments however.

Canker on cacao in Suriname has recently been studied by Van Hall de Jonge [30]. Her work lead her to the conclusion that the disease was caused by a new species of fungus, *Spicaria colorans*, perhaps the imperfect form of a Nectria. This fungus was isolated by cutting out bits of wood and bark just at the advancing margin of the disease and transferring them to sterile culture medium in tubes or petri dishes. In addition to the Spicaria stage the fungus had a Fusarium stage. The Fusarim macroconidia were found to be different from those of the common Nectria on cankered wood which she considered *N. striatospora* Zimm. Mrs. Van Hall was unable to reproduce the disease by inoculation either with bits of diseased bark or with spores from her pure cultures.

Last year Von Faber [31] published a lengthy monograph on cacao diseases occurring in the Dutch Colonies. The writer has not yet seen this paper but from a short review which he has read it is evident that Von Faber considers several species of Nectria as the cause of canker.

The writer [32] recently published a short note stating that canker in the tree could be produced by inoculation with Phytophthora, and that this fungus had been isolated from cankered bark some distance from a cushion.

From a study of the literature dealing with the pod-rot and the canker of cacao as outlined in the preceding pages, the following facts become apparent :—

1. A serious disease of cacao pods called either black-rot or brown-rot has been known in all cacao growing countries for the past fifteen years or more.

2. It has been proved by inoculation experiments with pure cultures that this disease is caused by a species of Phytophthora generally considered *P. omnivora* De B.
3. A disease of the cacao tree to which the name canker has been applied is also found in practically all cacao growing countries.
4. The descriptions of this disease which have been given leave little doubt that it is the same in all places.
5. A large number of different fungi, mostly belonging to the Nectria group, has been reported as the cause of this disease.
6. Canker has never been reproduced by inoculation with pure cultures of any fungus (with the exception of the writer's experiments), in fact the results were negative in the only instance in which pure cultures of the supposed causitive fungus were used.
7. The disease has only been produced artificially by inserting in wounds made in healthy trees, bits of diseased bark or pod, or spores of species of Fusarium, Nectria, or Calonectria taken directly from the surface of diseased bark.
8. A number of investigators have observed that the cushions bearing diseased pods frequently become infected, and *vice versâ* that pods frequently become infected from diseased cushions, but whether the same fungus caused both diseases has never been clearly shown.
9. For the control of the pod disease the gathering and burning of all diseased pods, and spraying has been recommended generally, while for the control of canker excision and burning of diseased patches and spraying are the remedies given.

Description of the Diseases.

The pod-rot and canker of cacao have been so frequently described and are met with so commonly on every estate that they are quite familiar to all who are acquainted with cacao cultivation. The common names which have been applied to these diseases however are somewhat misleading. The pod-rot caused by Phytophthora is generally known in the West Indies as black-rot, while in the East it is called brown-rot a name applied in the West to a different disease caused by *Diplodia cacaoicola*. To avoid confusion the writer would suggest that it be called simply pod-rot or perhaps better Phytophthora pod-rot. Moreover the names either black-rot or brown-rot are misleading for the rotted pods may be either brown or black in colour according to the age of the pod and stage of the disease.

Although the term canker is somewhat of a misnomer for the bark disease yet it is in such general use that it is retained in this paper. The term chupon-wilt has been applied to a disease described here for the first time which was met with frequently last year on a number of different estates.

Phytophthora Pod-Rot.

This disease may attack pods of any age from the very small chirellos to the mature pods ready for picking. The fungus causing it can gain entrance through the unbroken epidermis so that surface

wounds are not necessary for infection. On the small pods the point of first attack becomes evident as a small black dot which may be anywhere on the surface of the pod. The fungus once within the tissues grows very rapidly so that the whole pod becomes black, shrivelled, and dry within 24 or 48 hours. The rapid withering and drying of these pods frequently kill the fungus before it has time to produce any spores.

Later on these dead pods becomes covered with the mycelium and sporophores of various saprophytic fungi. (Plate X, fig. 4.)

It must not be understood that the death of all small pods is due to this disease, but as will be shown later undoubtedly an appreciable percentage of small fruits are lost each year on account of fungus attack.

The first evidence of the disease on the large pods, half to full grown, is a slight brownish discolouration about the points of infection, which may be anywhere on the surface of the pods but are generally at the tip or stem end. (Plate X, figs. 1 and 2.) The disease spreads very rapidly in all directions from the point of first attack. On the surface of the pod the line of demarcation between the healthy and diseased tissue is quite distinct, but in the fleshy tissues beneath the epidermis there is no such line and the disease will be found to be an inch or more in advance of the line showing on the surface. The whole pod becomes brown within the course of a few days and white powdery masses of spores begin to appear on the surface, especially along the furrows. (Plate X, fig. 3.) If the pod is not yet full grown and the seeds are still closely appressed to the inner surface of the husk the fungous mycelium soon penetrates the beans and destroys them. If the pod is almost ripe when first attacked and the seed mass is free from the inner wall the seeds may not become affected for some time. Numerous saprophytic fungi quickly follow up the disease and the whole pod eventually rots away if the weather is damp, otherwise it becomes black and shrivelled and may hang to the tree for some time. (Plate XI, figs. 1 and 2.) The rapidity with which the disease progresses can be realized when it is borne in mind that though most estates are picked over on the average of once every month or six weeks, and all pods showing disease are cut down, at each picking, especially in the rainy season, a goodly percentage of fruits show the disease in its last stages.

Canker.

Trees which are badly attacked by canker can readily be picked out by their general sickly appearance evidenced by dead branches, large numbers of black pods, chupons dying from the base upward and the lack of foliage, but by an examination of the bark superficially it is often difficult to locate the cankered areas unless they have reached the bleeding stage. The only sure method of locating canker in trees is by means of the diseased pods during crop season. If a half or full grown pod is seen rotting from the stem end outward it is almost always a sure sign that there is canker in the tree. When such a pod is cut off it will be found either that the cushion and a large surrounding area of bark is cankered or that fine strands of diseased tissue lead up or down to areas of canker.

When the outer bark is cut off from the cankered regions the diseased tissue below is found to be a claret colour and is generally surrounded by a dark line of cork cambium which separates it from the surrounding light yellow or pinkish healthy tissues. (Plate IX, fig. 1, and Plate XV, fig. 2.)

The extent of cankered area however can never be judged by the area that is diseased near the surface of the bark for deeper cuts show that the disease spreads chiefly in the innermost layers of the bark, in the cambium or even in the outer layers of the wood. When trees become badly diseased a thick reddish fluid is exuded from natural cracks or holes made by boring insects in the bark covering the cankered area. This liquid runs down the trunk giving the trees a rusty appearance.

Chupon-Wilt.

This disease was very prevalent on many estates last year. The chupon is generally first attacked in the soft tissue near the tip. A small water soaked area can be seen on the stem which gradually becomes sunken and darker in color and spreads up and down the stem frequently girdling the shoot and causing the upper part to wilt. The same disease has been observed on young shoots on the upper branches of the tree. The point of attack is generally in the axil of a leaf, though the leaf blade or petiole may be the first part affected, the disease afterwards running down into the stem.

Chupons are also frequently killed by aphides or other sucking insects, and such cases should not be mistaken for the disease of fungous origin. The final appearances of the killed shoots are the same but the initial stages are quite different.

Losses caused by these Diseases in Trinidad.

It is impossible to estimate exactly the losses caused by these diseases in Trinidad. In some of the older estates of the Island at least one quarter of the original trees have been killed out by canker while the bearing capacity of the remaining trees, the majority of which are more or less diseased, is greatly lessened. On many estates during the rainy season from 40 to 50 per cent. of the pods which are picked are rotted. The beans from the worst affected pods are of no value whatever and become entirely lost in either the fermentation or dancing process while those from the less severely attacked pods are always light in weight and easily broken. Moreover a large number of chirellos are killed which can only be roughly estimated at 10 to 15 per tree per year.

The chupon-wilt frequently makes it impossible to grow renews. Taking all things into consideration it is conservative to estimate that the out-put of cacao of the island would be from 40 to 50 per cent. more if these diseases were not present.

Cause of the Diseases.

The cause of the pod-rot, canker, and chupon-wilt is a fungus belonging to the genus Phytophthora which has been generally considered *P. omnivora*, but some of its characters are different from those of that fungus, and studies which are being carried on may show it to be autonomous. A description of the fungus follows :—

Cacao Phytophthora.

Conidiaphores break through the epidermis or stomata in dense masses, are long and generally unbranched, becoming decumbent and forming a rather dense hyphal network on the surface. Conidia are formed at the ends of the sporophores. When a spore is about half grown the growth of the sporophore is continued by a branch, arising immediately beneath the spore, which in turn forms a spore, at its tip. Spore formation continues as long as favourable growth conditions exist. There is no swelling of sporophores below conidia. Conidia vary in shape from narrow to broad ovate and in size from 30–60 × 21–30 microns but are usually 30–50 × 25–27 microns, and have a prominent germinal papilla. Spore wall is thin, smooth and colourless. Contents granular and colourless. The spores germinate either by emitting from 15 to 30 biciliate zoospores or with one or more germ tubes. Chlamydospores abundant 30–50 microns in diameter. Oospores are spherical, 33–40 microns in diameter, with colourless, thick, smooth wall and granular contents. Are formed on the surface and within the tissues.

This fungus differs from the European type of *P. omnivora* in its longer sporophores, smaller conidia, and larger oospores.*

Sources of Infection.

Diseased pods are undoubtedly the chief souree of infection for all these diseases. During the rainy season spores are produced in enormous quantities on the surface of diseased pods. These spores may be blown by wind, washed by rain or carried by insects to other pods where they quickly germinate, and reproduce the disease. From the fact that there are always pods on the tree the disease is kept going month after month and year after year. In addition to the spores borne on the surface of the pods the resting spores which are formed within the rotted tissues also aid in the distribution of the disease and can tide the fungus over long periods of drought or other unfavourable conditions.

Though canker may get into the trees through wounds made by the goulette or cutlass the diseased pods are unquestionably the chief source of infection of the tree.

Hundreds of cushions bearing pods which had rotted from the point to the stem have been examined and found cankered. The disease at times affects the whole cushion, but often is observed only as a few discolored strands, which however can be traced up or down the stem and sooner or later spread out into large canker patches. Chupons readily become infected from spores which are carried by rain or insects from diseased pods.

Other Fungi associated with the Diseases.

In addition to Phytophthora a number of other fungi are nearly always found associated with pod-rot and canker. As many of these

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*Through the kindness of Professor H. H. Whetzel of Cornell University in sending the writer cultures of the American form of *P. omnivora* cross inoculations are being made with the two fungi. Professor Whetzel has also kindly consented to test the cacao fungus on ginseng. The result of this work together with an examination of European material will make it possible to establish the identity of the cacao fungus.

have been reported as parasites, and considered the cause of pod-rots and canker as complete a collection of them as possible was made. On diseased pods in addition to the Phytophthora, at least three different species of Fusarium were found as well as several Nectrias, a Calonectria and two species of Sphærostilbe. On cankered bark two species of Fusarium have nearly always been found, two Nectrias, two Calonectrias and two species of Sphærostilbe. These fungi have been identified as far as possible. The commonest Nectria found on both pods and bark is *Nectria theobromæ* which Massee described originally from material sent to Kew from Grenada by Howard. Mrs. Van Hall reports and figures the same fungus from Suriname. This fungus is not *Nectria striatospora* Zimm. The latter is the common Ceylon Nectria to which the canker there was ascribed first by Carruthers. The ascospores of this species are smaller than those of N. *theobromæ* and the conidia spores of the Fusarium type are also much smaller. Another Nectria frequently found on diseased pods is *N. bainii* Massee. A Calonectria which has not yet been determined has also been found on pods as well as an undetermined Nectria with very small spores. On the bark in addition to *N. theobromæ*, *Calonectria flavida*, an undetermined Spharostilbe and *Spicaria colorans*, have been frequently found.

CULTURAL STUDIES.

Single spore cultures of all these fungi have been made. In making these cultures the method advocated by Dr. Erwin Smith has been used. In the case of the Nectrias, Calonectrias and Spærostilbes single perithecia were picked off with a sterile needle, mashed up in a drop of sterile water which was then put into a tube of melted agar and poured out into a petri dish. When the agar became hard the dish was turned upside down and a search for the spores made under the microscope with a medium power lens. The position of several isolated spores was marked on the bottom of the dish. These spores were then cut out and transferred to sterile agar in petri dishes and their growth watched under the microscope, and transfers were made later to tubes. Pure cultures of the Fusariums and Phytophthora were obtained by the ordinary poured plate method.

In addition to the cultures made from spores found on the surface of the diseased pods and bark, cultures were made directly from the diseased tissues themselves. Pods in which the rot had just started were selected for this work. They were washed thoroughly with water and then soaked in a solution of mercuric chloride 1·1000 for 10 minutes. Then with a hot knife a slice was quickly cut off along the advancing margin of the disease. With a cold sterile knife small bits of the diseased inner tissues were cut out and immediately transferred to sterile media in tests tubes. Cultures were made from cankered limbs and branches in the same way as well as from the wilted chupons.

Cultures made by this method from diseased pods and wilted chupons have invariably given a pure growth of Phytophthora, but those from cankered wood have generally given a variety of different fungi. In some cases pure cultures of Phytophthora were obtained but often *Nectria theobromæ* and *Spicaria colorans* were got, and rarely *Diplodia cacaoicola.*

During the past year 275 cultures have been made of the fungi associated with canker.

Life History of Cacao Phytophthora.

So far as the writer has observed this fungus passes its whole life history in parts of the cacao tree or fruit. The fungus produces conidia spores abundantly on diseased pods, and rarely on diseased bark. (Plate XVII, figs. 1 and 2.) If placed in water these spores germinate within 30 minutes by letting out from 10 to 30 small zoospores which after swimming about for a variable length of time, generally about 10 to 15 minutes lose their cilia, or organs of locomotion, becomes spherical and within an hour will send out a germ tube. (Plate XVII, figs. 3, 4, 5, 6, 7 and 8.) If the spore has germinated in a drop of water on a cacao pod the small germ tube soon gains entrance to the inner tissues of the pod either by penetrating the epidermis or making its way in through a stoma. Once within the pod the fungus grows very rapidly absorbing food from cells and spreading throughout the tissues causing the characteristic brown discoloration. The mycelium is rather coarse and non-septate and of varying thickness, being in some places rather narrow while in others quite swollen. (Plate XVII, fig. 1.)

If the large spores fall on a damp surface rather than in water they will not form zoospores, but will germinate by means of one or more germ tubes which may either enter the pod directly or produce other spores on the surface of the pod, which in turn will germinate either by forming zoospores or germ tubes.—(Plate XVII, fig. 9, 10 and 11.)

After a few days' growth within the pod the mycelium begins to mass up at points just beneath the epidermal layers of cells, frequently in the substomatic chambers. The pressure of this mass of mycelium finally ruptures the epidermis and rather slender hyphae grow out through the opening so formed. The tips of these hyphae soon begin to swell, and finally become the characteristic lemon-shaped spores When the spore is about half grown the sporophore sends out from a point just below the spore a branch which in turn will form a spore at its tip.—(Plate XVII, fig. 1.) This spore production from a single original sporophore goes on as long as nourishment is supplied and weather conditions are favourable. With the continued growth of these sporophores a rather dense fungal network is formed on the surface of the pod. Underneath this mycelial mass two other kinds of spores are found. The first are formed much as are the conidia already described, but are spherical, and so far as has been observed always germinate with germ tubes. They are quite variable in size and probably belong to the type of spores known as chlamydospores. Oospores are also formed in the net work of mycelium on the surface of the pod.

Almost simultaneously with this superficial spore production oospores are formed within the tissues of the pod, especially in the soft layer of tissue between the hard inner pod wall and the epidermis. (Plate XVII, figs. 12, 13, and 14.) These oospores serve as resting spores and may retain their vitality for a long time and carry the fungus over long periods of unfavourable conditions. The oospores

are set free by the decay of the pods and germinate with a short germ tube which forms a spore of the ordinary type at its tip.

When the tissues of the pod at the stem end have become well invaded by the fungus, the mycelium runs back into the cushion either through the bark or the central woody cylinder of the stem of the pod, or through both. If it has gained entrance to the tree through the thin bark layer of the pod stem it generally spreads out in all directions so that the whole cushion and surrounding area of bark becomes cankered (Plate IX, fig. 2, and Plate XV, fig. 2); but on the other hand if the mycelium grows into the tree through the woody part of the pod stem the cushion may not become cankered. The mycelium will extend in narrow lines for some distance up or down the stem in the cambium layer but sooner or later will grow outward into the bark and then spread out rapidly forming larger cankered areas. (Plate IX, fig. 1, and Plate XV, fig. 1.)

As the tissues of both pod and bark are killed by the advancing margin of growth of the Phytophthora mycelium they are quickly invaded by a number of rapidly growing fungi as mentioned above which produce spores very quickly on the diseased tissue. There can be no question that these fungi aid in the rapid disintegration of the already diseased pod tissues and are responsible to a certain extent for the characteristic appearance of cankered bark, but that they are not parasitic and cannot even attack tissues which have been wounded mechanically has been proved by a larger number of inoculation experiments.

Inoculation Experiments.

Considering the fact that cacao canker has been ascribed to a number of different fungi, though the characters of the disease have always been much the same, and that great difference of opinion has existed as to the relation of canker and pod disease, a series of inoculation experiments was started in the latter part of 1909 with the hope that some of the doubtful points might be cleared up. By the method described previously pure cultures, originating from single spores, of a number of different fungi associated with pod-rot and canker were obtained. These strains have been kept pure and all inoculations have been made from them. Before field inoculations were begun preliminary tests were made with the different fungi on half to full grown pods kept in moist chambers in the laboratory. The surface of the pods was thoroughly washed in tap water, then in sterile distilled water. One set of pods was inoculated by inserting the fungus spores from the cultures in small wounds made with a sterile bistoury and another set by simply placing the spores in drops of water on the unbroken epidermis.

The following fungi were used:—*Phytophthora omnivora* (?), *Diplodia cacaoicola*, *Nectria theobromæ*, *N. bainii*, two species of Calonectria one of which is doubtless *C. flavida*, two species of Sphaerostilbe, neither of which has yet been determined and *Spicaria colorans*. After inoculation the pods were examined daily for a month. The pods inoculated in wounds with Phytophthora and Diplodia began to rot very quickly and were completely rotted within ten days. The pods inoculated with Phytophthora spores simply put on surface rotted almost as quickly, but those inoculated with Diplodia

in this way rotted much more slowly. None of the pods inoculated with the other fungi rotted, even in the cases where punctures were made; the tissues remained sound and there was only a slight discoloration immediately about the puncture. The field inoculations were made on a block of cacao trees of different varieties well isolated from other cacao trees. The trees were free from canker and the pod disease. In all over 150 inoculations have been made with the different fungi, and have generally been made in series so that the conditions for each fungus would be the same; in all cases checks have been made.

Inoculations were made in two ways, in the first the bark of the tree or epidermis of the pod was wounded and the inoculating material put into the wounds, in the second the spores were suspended in water which was sprayed on the bark or pods with an atomizer. In the majority of cases where wound inoculations were made on suckers, limbs or trunks of trees the inoculated area was covered with a layer of surgical gauze and then wrapped with grafting tape in order to keep the wounds from drying out too quickly, but no attempt was made to keep the wounds moist artificially and the wrappings were always removed after 7 to 10 days. Too much space would be required to give the whole list of inoculations and little would be gained as in many cases it would be simply repetition so that only some of the most striking ones will be given in detail. In all cases in order that there might be no doubt that there were spores in the cultures used for inoculation microscopic preparations were made and examined just before the inoculations were made, and to show that the spores were active transfers were made from each tube to fresh sterile agar in tubes.

As it was quite unlikely that all the species of Nectria, Sphaerostilbe, Calonectria, etc., which had been isolated from diseased pods and bark were parasitic a set of inoculations was made in January for the purpose of weeding out the saprophytes. Vigorous growing trees of from 3 to 4 inches in diameter were selected for the work. The inoculations with each fungus were made in exactly the same manner, namely, with a sterile knife a small cut about ½ inch long was made in the bark and with a sterile platinum needle spores were transferred from the pure cultures to the cuts. The wounds were then immediately bound up as described above. (The surgical gauze was used simply to keep the tape from sticking to the bark). At this time eight inoculations were made with Phytophthora, five with *Nectria theobromæ*, five with *Spicaria colorans*, five with *Diplodia cacaoicola*, and three with each of the other fungi mentioned. Five cuts were made and wrapped in a similar fashion to serve as checks.

The wrappings were taken off from all the inoculations and checks after 8 days. Even in this short time there was evidence that the inoculations made with Phytophthora were taking effect. The following notes were made:—"I think that there is no question that "the fungus is working. Within a radius of from one to two inches "about the points of inoculation the bark is darker than normal, and "when a very thin layer is cut off the tissues below are darker there "than they should be and have a water soaked appearance."

The inoculations made with all other fungi, with the exception of those in which Diplodia was used, appeared in no way different from the check wounds except that in some cases there was a slight fungous growth just in the margin of the cuts. When thin layers of bark were cut off however the tissues beneath were perfectly healthy.

An exactly similar set of inoculations were made on February 11 and gave exactly the same results. In every case in which Phytophthora was used a disease in the bark was produced while the inoculations with all other fungi except Diplodia remained the same as the checks.

In all between 80 and 90 inoculations have been made in the bark of trees and the results from all have been uniformly the same, none of the fungi used except Phytophthora and Diplodia have proved to be parasitic even in the slightest degree.

The only conclusions which can be drawn from these experiments are that *Nectria theobromæ*, *N. bainii*, *Calonectria flavida* and *Spicaria colorans* when grown in pure culture and inoculated in fresh wounds in healthy cacao trees are incapable of attacking the healthy tissues and producing disease; that both *Phytophthora omnivora* (?) and *Diplodia cacaoicola* attack healthy tissues and produce disease when inoculated into wounds in cacao trees. Whether the disease caused by either of these fungi was canker remained to be settled. Though Diplodia is undoubtedly a wound parasite the disease which it produces is very evidently not the common canker. This fungus grows into the wood and attacks it at first rather than the bark, so that the whole stem becomes blackened through and through and the bark becomes brown and dry and does not assume the neutral tint or claret colour characteristic of canker. The writer's experiments with this fungus agree closely with those reported by Howard.[18]

The disease produced by inoculations with Phytophtora however shows the characteristics of canker. The fungus spreads rapidly in all directions in the bark and the attacked tissues at first assume the "neutral" tint and later on become claret coloured, and are generally surrounded by a dark line of cork cambium. (Plate IX, Figs. 1 and 2; Plate XIII, Figs. 1 and 2; Plate XV. Figs. 1 and 2.)

The writer upon several occasions has shown specimens of the disease produced by inoculation to cacao planters who have at once diagnosed it as canker, and to Mr. Carruthers, Assistant Director of Agriculture who said that the specimens were very like the disease as it occurs in Ceylon.

The trees inoculated in February have been examined frequently up to the time of writing and not only do they show cankered areas about the point of inoculation, but other diseased patches are appearing on the tree, all of which however can be traced back to the original point of infection. In some cases however the disease has evidently died out after progressing to a certain point, and new bark is now being formed under the affected area.

To show that the disease can gain entrance to the tree through the pods a number of inoculations were made. Pods of all ages from the chirellos to the mature fruit, were inoculated with Phytophthora. Twenty-five inoculations of this kind have been made.

In every case the pod rotted quickly and in many cases where the pods were over half grown the disease ran back into the stem. With the case of the small chirellos however it was different. They all became diseased but dried up so quickly that the fungus evidently did not have an opportunity to run back into the stem. This bears out observations made in the field.

The rapidity with which the disease progressed in some of the inoculations is shown by the following notes from the writer's note book:—

"No. 11. February 10, 1910—Phytophthora. Inoculated $\frac{3}{4}$ grown pod about 2 inches from the stem end. February 19.—Pod is two-thirds rotted and Phytophthora fruiting abundantly on the surface. The somewhat darkened appearance of stem would give evidence that the disease is running back into the cushion. February 25.—Pod completely rotted and is beginning to shrivel up and become hard as the weather has been quite dry. March 12.—Cut off limb and photographed with pod attached. (Plate XI, Fig. 1.) Then cut off pod. Canker had run back in fine strands through the cushion and then spread out in the bark above and below. Photographed. (Plate XV, Fig. 1.) Specimen in alcohol."

"No. 11.5. February 10, 1910.—Phytophthora. Inoculated larger of two pods from one cushion. February 19.—Pod nearly all rotted. February 25.—Small pod rotted as well. Disease has evidently run back into cushion. March 12.—Both pods thoroughly rotted (Plate X, Fig. 4.), and canker spreading in bark about cushion."

Inoculations similar to Nos. 11 and 11.5 have been made repeatedly, and in by far the greater number of cases the disease has run back into the tree. These experiments together with a large number of field observations have led the writer to believe that the pods serve as the chief source of canker infection.

Other sets of inoculations were made to show that the disease in the tree could run out into the pods. In this case the stem was inoculated above or below a pod, or to one side or the other. A number of successful inoculations were obtained in this way. To quote from the note book again:—

"No. 10. February 11, 1910.—Phytophthora. Inoculated limb about 2 inches above a $\frac{3}{4}$ grown pod. Culture originally obtained from canker. February 19.—Took off tape. Inoculation taking effect; area about point of inoculation watery looking. February 25.—Cut off and photographed. (Plate XIV, fig. 2.) Phytophthora is fruiting abundantly on pod. White fungus in cracks of bark about point of inoculation is the Fusarium stage of *Spicaria colorans*. This shows how quickly the saprophytes follow. The stem of pod when cut through is brown and purplish just like canker. (Plate IX, fig. 3.) Tissue was reddish or purple all about both above and below cushion, photographed." (Plate VIV, fig. 3.)

"No. 9. February 11.—Phytophthora. Inoculated small limb bearing chirello. Inoculation made 2 inches below

pod and on opposite side. February 24.—Taking effect area above inoculation is sunken. March 18—Pod is shrivelled and partially blackened. Limb has been girdled by canker." (Plate XIV, fig. 1.)

In addition to Phytophthora the other fungi were all inoculated into pods, but none save Diplodia made any growth, all others remained like the checks. Mature pods when wounded and inoculated with Diplodia rotted but the disease did not run back into the stem so far as observed.

The results of the experiments in which the spores of the fungi were suspended in water and sprayed on the fruits and bark with an atomizer were all negative save where Phytophthora spores were sprayed on pods and young shoots during a period of wet weather. In these cases as was to be expected the fungus gained entrance to the tissues and caused disease, but whether Phytophthora hyphæ can penetrate the outer bark of older limbs has not yet been determined.

Conclusions.

Field observations made on many estates in Trinidad, and cultural and inoculation experiments as described have led the writer to conclusions at variance with those held by other investigators who have studied canker and pod-rot of cacao. There can be no doubt that the rot of the pods and canker are the two most serious diseases of cacao in Trinidad. That a species of Phytopthora was the cause of the former has been known for some time, and proved by inoculations. Moreover this fungus belongs to a group of fungi well known to be parasitic. Potato blight, and the downey mildew of the lima bean, grape, cucumber, and onion, as well as the damping off disease of a number of plants are all caused by closely allied fungi.

Although a number of different fungi all belonging to the genus Nectria or nearly related genera has been considered the cause of canker, their parasitism has never been proved by inoculation experiments with pure cultures. Inoculations made by using bits of diseased bark or pods, and spores taken directly from the surface of diseased material cannot be relied upon especially in the tropics and in dealing with diseases of the type in question. Mycelium of a number of different fungi could be present in the bits of diseased bark and pods and more than one kind of spore could readily be introduced into the inoculation wound, when spores are taken from sporodochia or perithecia on diseased material. The writer has thoroughly convinced himself of this point by making petri dish cultures from spores taken in such a manner.

When inoculations have been made with pure cultures of a number of these fungi the results have been uniformly negative so that *Nectria theobromæ*, *N. bainii*, *Calonectria flavida*, two undetermined species of Sphaerostilbe frequently found on cankered cacao bark, and *Spicaria colorans* can not well be considered as the cause of cacao canker, or of the cacao pod disease.

A large number of inoculation experiments made by the writer with pure cultures of *Phytophthora omnivora* (?) proves conclusively that this fungus is the cause of the common cacao pod-rot and of the

disease known as canker, and that the diseased pods serve as the chief source of infection of the tree.

Preventive Measures.

To control the pod disease two methods have generally been recommended. One is to gather and destroy all pods as soon as disease is noticed on them, and to husk "black cocoa" apart from the sound, and to burn, bury, or lime all the husks; the other, to prevent the disease by spraying.

Methods similar to the first have been frequently recommended for the control of a large number of fruit diseases, but from the fact that it is impossible to gather and destroy all the fruits of whatever kind as soon as they become diseased and that the fungi causing diseases of this type produce spores within a very short period from the time of first infection, the method is of a theoretic rather than of a practical value. It has long since been given up as a means of controlling such diseases as brown-rot of the peach, bitter-rot of the apple, black-rot of the grape, and other fruit diseases. Moreover a number of Trinidad planters who have tried this method as a means of controlling the cacao pot-rot have told the writer that though the disease was reduced to a certain extent the cost of the labour used in collecting and destroying the blackened pods was in no way compensated for by the increased returns from the general pickings, so that they gave up the method after a short trial.

When the fact is considered that in the rainy season a pod may become infected and completely rotted within a week or ten days and that within three or four days from the time of infection hundreds of thousands of spores are produced, each one of which in germinating liberates from 10 to 30 smaller spores each capable of reproducing the disease it can be readily understood how futile it is to attempt to check the disease by gathering and destroying the diseased pods.

The method of control by spraying, which has proved so successful in combatting similar diseases in temperate climates, is undoubtedly the best to use against pod-rot. Although a sufficiently large number of experiments have not been carried out either in Trinidad or elsewhere to make it possible to give the best recommendations as regards to time of spraying, mixtures to use, etc., yet the work which has already been done shows conclusively that the disease can be controlled by spraying at a reasonable cost, that is at a cost which is more than compensated for by the increased yield. Up to the present time the writer has definite results from two sets of experiments.

During the past eight months 2,125 more sound pods have been picked from 500 sprayed trees than from 500 adjacent unsprayed trees, and the sprayed trees have yielded in the total 1,608 more pods. Twenty-five per cent. of the cacao from the unsprayed trees has been "black" while only 9 per cent. of that from the sprayed trees has been so.

Though there has not been much "black cocoa" during the past five months yet in another experiment 2,415 more pods have been picked from 500 sprayed trees than from the same number of adjacent unsprayed trees. This increase in yield is due to the fact that the small fruits were protected from fungus attack.

The methods advocated for the control of canker have been the excision of the diseased tissues; the reduction of shade, better drainage, and the exercise of more care in picking and pruning so that the trees be not wounded unnecessarily. The object of cutting out the diseased tissue was to free the trees from disease, and the other recommendations were for the purpose of preventing reinfection by producing conditions less suitable for fungous growth. Though it has been observed that canker is less prevalent in places where trees have been sprayed, the value of spraying as a method of controlling the disease has never been fully appreciated. It becomes self-evident however when it is understood that the diseased pods are the chief source of canker infection rather than wounds of various kinds. No matter how carefully all the canker has been cut out, trees will always become reinfected if the pod disease is not controlled.

The evil effects of the needless wounding of trees with the goulette and cutlass and the results of improper pruning are so well known to every planter that the writer need say nothing on this subject. That most estates need better drainage is also a fact that needs no comment.

From a purely mycological standpoint the reduction or total removal of shade trees would greatly tend to reduce fungous growth on cacao estates, though both pod-rot and canker are widespread in Grenada, but from a practical standpoint the writer cannot give any advice on this subject as he has never been in any cacao growing country other than Trinidad.

Recommendations.

Although spraying in connection with tropical horticulture and agriculture is still in its experimental stage results which have been obtained in both Trinidad and Ceylon show that it is the most practical and successful method of controlling both pod-rot and canker of cacao, but as stated before sufficient work has not yet been done to make it possible to give the best recommendations in regard to time of spraying, best mixtures and spraying machinery. But the suggestions got from the experiments as far as they have gone are that for the best results trees should be sprayed at least four times a year the applications being made when the trees are well covered with young fruits. This will make two applications on each crop. But from the fact that the trees have cacao on at nearly all times of the year a spraying at any time would do some good. However, spraying should be avoided at the periods when the trees are in full bloom. The usual methods for cutting out canker should be followed but to make this work of value and to keep the trees healthy spraying should be resorted to.

At some future time perhaps when estates are perfectly drained and cacao is grown without shade much less disease will be met with, but until that time comes both canker and pod-rot must be controlled by spraying.*

Bibliography.

1. 1833.—Porter, G. R. The Tropical Agriculturist. A Practical Treatise on the Cultivation and Management of various Productions suited to Tropical Climates. London, p. 98.

2. 1844.—De Verteuil, L. A. A. Trinidad. Its Geography, Natural Resources, Administration, Present Condition, and Prospects. Cassell & Co., London, Paris and New York. Second Edition, p. 242.

3. 1895.—Harrison, J. B. Cacao disease in Grenada. Quoted in Bulletin Miscellaneous Information, Botanical Department, Trinidad. 3 : 167, April, 1899.

4. 1897.—Harrison, J. B. Report on Agricultural work in the Botanic Gardens, British Guiana. The portion relating to cacao reprinted in Proceedings of the Agricultural Society of Trinidad and Tobago. 2: 220–254, September 14.

5. 1897.—Willis, J. C., and Green, E. E. The cacao canker. Royal Botanic Gardens, Ceylon, Circular. Series I.—No. 2, pp. 5–11. August 7. Reprinted in Tropical Agriculturist. 17 : 272, 273. 1897.

6. 1897.—Morris, D., Massee, G., and Willis, J. C. The cacao canker, II. Royal Botanic Gardens, Ceylon, Circular. Series I,—No. 3, pp. 13–21. November 6. Reprinted in Tropical Agriculturist 17 : 430–432. 1897.

7. 1898.—Carruthers, J. B. Interim report on cocoa disease. Printed by Planters' Association of Ceylon, pp. 1–11, March 26. Reprinted (without table of inoculations) in Tropical Agriculturist, 17 : 851–854, 1898.

8. 1898.—Carruthers, J. B. Second report on cacao disease. Printed by Planters' Association of Ceylon, pp. 1–12. October 8. Reprinted in Tropical Agriculturist 18 : 359–362.

9. 1898.—Carruthers, J. B. Additional report on cacao disease. Printed by Planters' Association of Ceylon, pp. 1–8. December 17, Reprinted in Tropical Agriculturist 18 : 505–507.

10. 1898.—Hart, J. H. Cacao disease. (Agricultural Society Paper No. 100.) Proceedings of the Agricultural Society of Trinidad and Tobago, 3 : 122, 123. September 13.

* A Bulletin discussing spraying methods and spraying problems is in course of preparation and will be issued towards the end of the year. In this Bulletin will be given the complete results of the experiments which are being carried on, the mixtures and machinery used and the cost of application. An outline of the first experiments together with the best method of making Bordeaux mixture was given in the April number of the Bulletin.

Bibliography.—*Continued.*

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11. 1899.—Marryat, A. P., Carmody, P., and Hart, J. H. Report of the Cacao Committee on "Cacao pod disease". (Agricultural Society Paper No. 111). Proceedings of the Agricultural Society of Trinidad and Tobago, 3: 203–206. March 14.

12. 1899.—Massee, G. Cacao pod disease. Bulletin of Miscellaneous Information, Royal Gardens, Kew. No. 145, 146, pp. 1–6. 1 Plate, January and February. Reprinted with notes by Hart in Bulletin of Miscellaneous Information, Botanical Department, Trinidad, 3: 167, 168. April. West Indian Bulletin, 1: 422-427. 1900.

13. 1899.—Hart, J. H. Cacao pod disease. Bulletin of Miscellaneous Information, Botanical Department, Trinidad, 3: 167, 168. April.

14. 1899.—*Ibid.* 3; 182–185. July.

15. 1899.—Massee, G. Diseased cacao bark from Trinidad. (Agricultural Society Paper No. 132). Proceedings of the Agricultural Society of Trinidad and Tobago, 3: 317, 318. December 12.

16. 1900.—Carruthers, J. B. Proceedings of the Linnean Society, London. 112th Session, p. 7. October.

17. 1901.—Carruthers, J. B. Cacao canker in Ceylon. Royal Botanic Gardens, Ceylon, Circular. Series I, No. 23. October.

18. 1901.—Howard, A. The fungoid diseases of cacao in the West Indies. West Indian Bulletin, 2: 190–211. Reprinted with notes by Hart in Bulletin of Miscellaneous Information, Botanical Department, Trinidad, 4: 365–383. August.

19. 1904.—Hemple, A. A new species of fungus producing canker in cacao trees. Boletim de Agricultura, São Paulo, 5 ser., No. 1, pp. 22-24.

20. 1905.—Busse, W. Report of the phytopathological expedition of the colonial agricultural committee to West Africa. Der Tropenpflanzer, 9: 25–37. January.

21. 1905.—Lewton-Brain, L. Fungoid diseases of cacao. West Indian Bulletin, 6: 85–94.

22. 1906.—Stockdale, F. A. Cacao disease in Trinidad. Agricultural News, Barbados, 5: 266. August 25.

23. 1907.—Petch, T. Annual Report of the Mycologist. Tropical Agriculturist, Supplement to Volume 29, No. 2.

Reprinted in part in Proceedings of the Agricultural Society of Trinidad and Tobago, 7: 181–185.

24. 1907.—Barrett, O. W. Cacao pests, preliminary report. (Agricultural Society Paper No. 253). Proceedings of the Agricultural Society of Trinidad and Tobago, 7: 107–120.

25. 1907.—*Ibid.* Cacao cultivation. (Agricultural Society Paper No. 257.) *Ibid.*, 7: 131–146.

Bibliography.—*Continued.*

26. 1907.—*Ibid.* Cacao cultivation. (Agricultural Society Paper No. 263.) *Ibid.*, 7 : 167–174.

27. 1907.—*Ibid.* Cacao pests of Trinidad. (Agricultural Society Paper No. 280.) *Ibid.*, 7 : 281–304.

28. 1908.—von Faber. F. C. Investigation of the cacao canker disease in the Cameroons. Arbeiten aus der Kaiserlichen Biologischen Anstaltfür Land-und Forstwirtschaft, 6 : 395–406. Plate 11.

29. 1909.—Stockdale, F. A. Fungous diseases of cacao. West Indian Bulletin, 9 : 166–187.

30. 1909.—van Hall—de Jonge, A. E. Canker or red rot of cacao trees caused by *Spicaria colorans* n. sp. Department van den Landbouw, Suriname, Bulletin No. 20. November. Reprinted in Traveaux botaniques Neerlandais, Volume 6.

31. 1909.—von Faber, F. C. The diseases and parasites of cacao trees. Arbeiten aus der Kaiserlichen Biologischen Anstalt für Land-und Forstwirtschaft, 7 : 193–351. 2 Plates.

32.—1910.—Rorer, J. B. The relation of black-rot of cacao pods to the canker of cacao trees. Bulletin, Department of Agriculture Trinidad, 9 : 38. April.

Description of Plate IX.

Cacao canker. 1.—Canker produced in stem by inoculating a pod with Phytophthora. In this case the disease did not spread to a great extent in the outer bark surrounding the cushion but extended down the stem in a narrow streak. 2.—Canker produced n stem by inoculating a pod with Phytophthora. In this case the bark surrounding the cushion was badly attacked by the disease. 3.—A cushion which has become diseased from an inoculated pod. The disease is running back both through the bark and the wood.

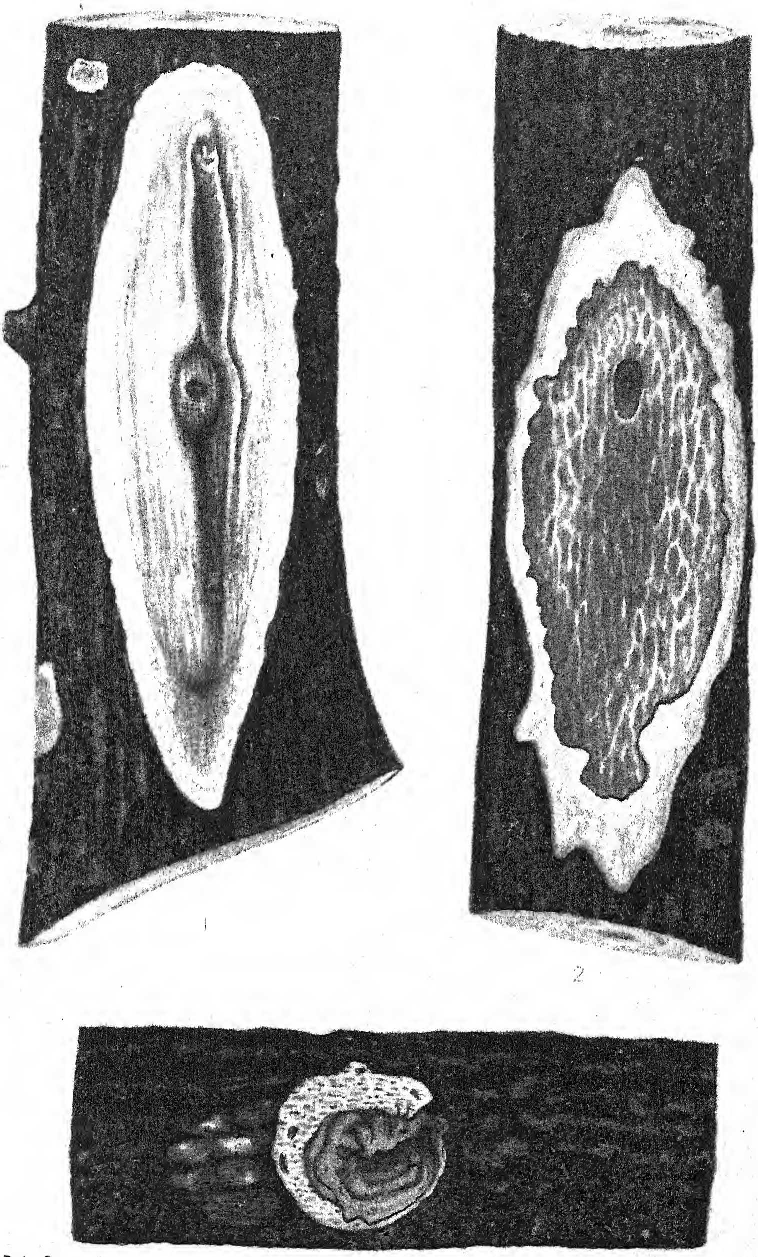
In order not to delay the publication of the Bulletin Plate IX, a coloured plate, which has not yet been received from the lithographers is omitted. Copies of this plate will be sent out later, and should be inserted so as to face this page.

The enclosed illustration is Plate IX of Bulletin 65, Vol. IX, Department of Agriculture, Trinidad, and should be inserted in that number of the bulletin so as to face page 104 on which will be found the description.

Sincerely,

JAMES BIRCH RORER.

PLATE IX



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CANKER IN CACAO STEMS AND CUSHIONS PRODUCED BY INOCULATION

Description of Plate X.

Fig. 1.—A cacao pod showing the Phytophthora rot just beginning at the point end. This was a natural infection. Fig. 2.—A cacao pod in which the rot began at the stem end. Fig. 3.—A cacao pod entirely rotted showing Phytophthora sporophores and mycelium on the surface. Fig. 4.—Two cacao pods entirely rotted and shrivelled. The surface is covered with saprophytic fungi. Fusarium sporodochia can be seen on the stems of both pods.

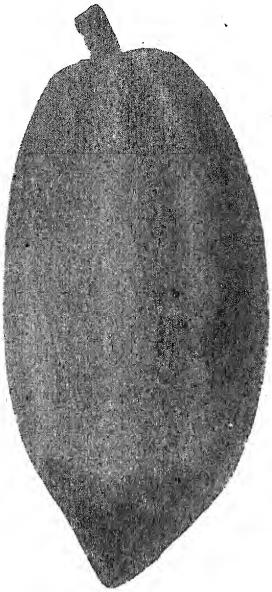


FIG. 1. A cacao pod, showing Phytophthora rot just beginning at tip.

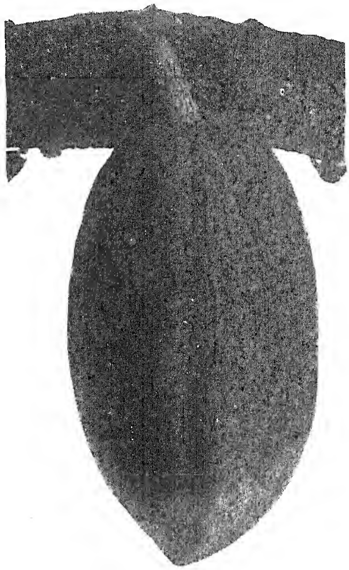


FIG. 2. A cacao pod rotted from the stem end outward.

FIG. 3. A cacao pod completely rotted, showing Phytophthora fruiting on the surface.

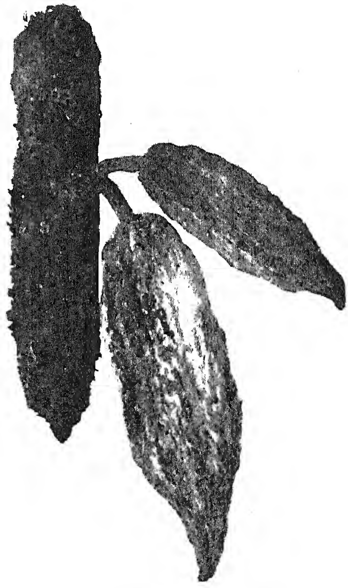


FIG. 4. Two young cacao pods completely rotted.

Description of Plate XI.

Fig. 1.—A cacao pod completely rotted. In this case the rot was produced by inoculating the pod with spores from a pure culture of Phytophthora. The inoculation was made on February 11, and the photograph was taken one month later.

Fig. 2.—A pod of *Theobroma pentagona*, the alligator cacao, in which the rot was produced by inoculation. Inoculation made on April 2, and the photograph taken on April 23.

In both cases the disease had run back into the stem as is shown in Plate XV. The white masses on the surface of the pods consists of enormous quantities of spores of Phytophthora, as well as of various saprophytic fungi.

PLATE XI.

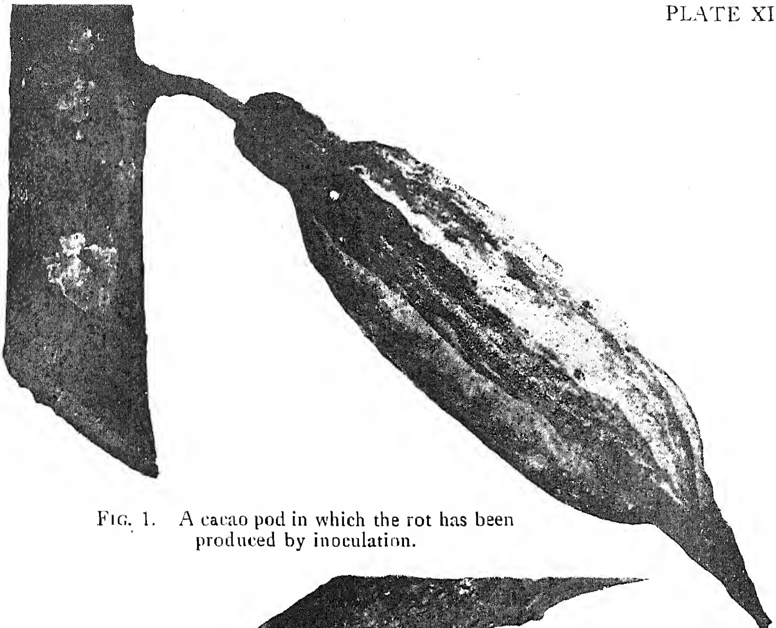


FIG. 1. A cacao pod in which the rot has been produced by inoculation.

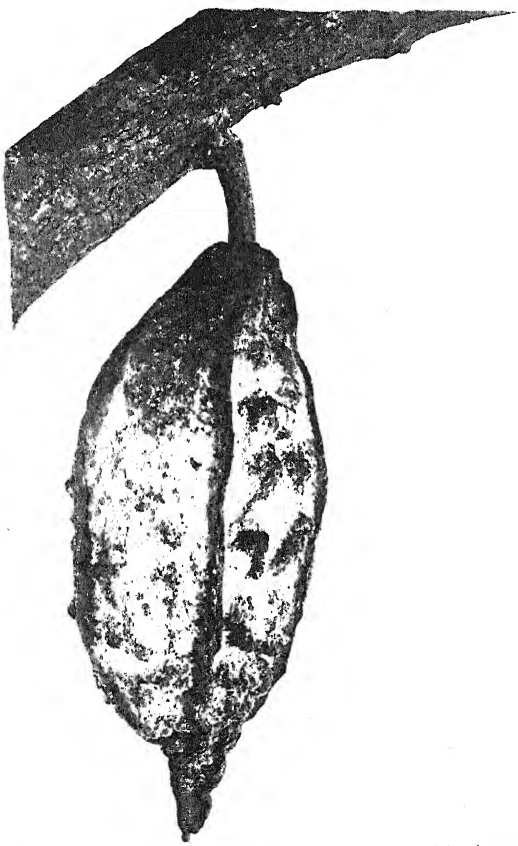
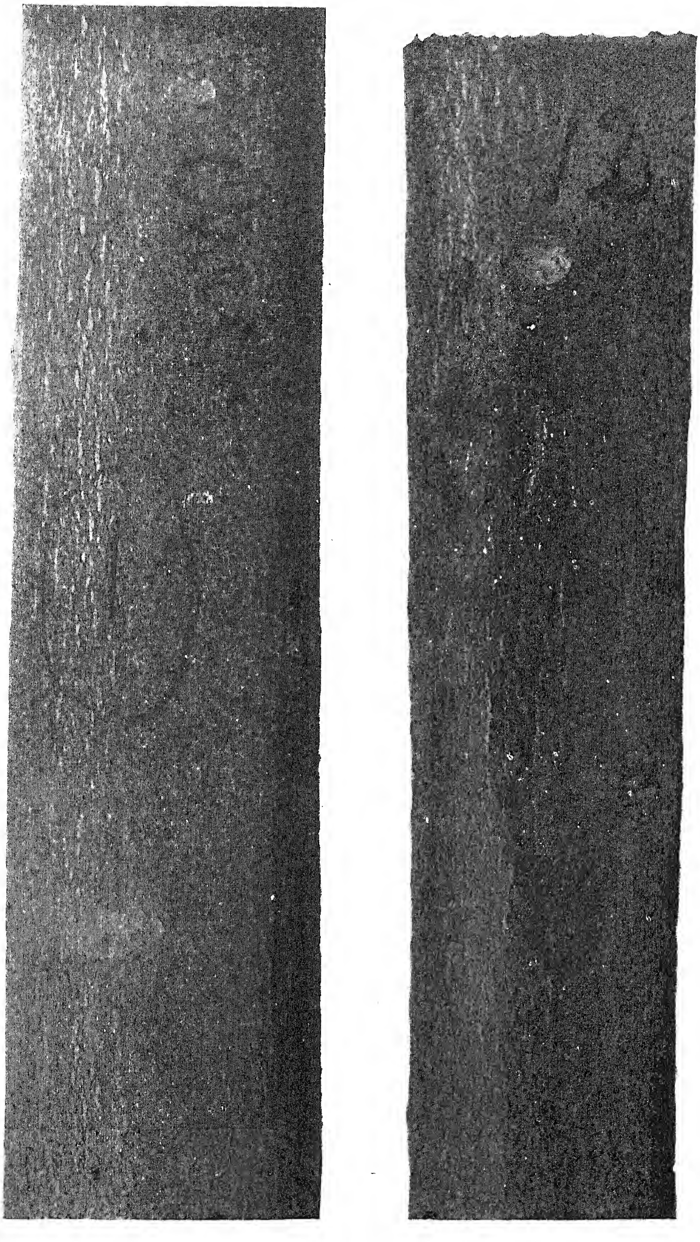


FIG. 2. A cacao pod in which the rot has been produced by inoculation.

Description of Plate XII.

Two sections of cacao trees. The one on the right was inoculated on February 11 with a pure culture of Phytophthora obtained originally from a diseased pod. The section in the left shows check puncture made at the same time. The photograph was made on February 25. The darkened area of bark shows the effect of the inoculation. The small white pustules about the point of inoculation are sporodochia of Fusarium.



Two sections of cacao trees, one showing check puncture, the other canker produced by inoculation.

Description of Plate XIII.

Inoculated stem shown in Plate XII with the bark cut off at different depths. In Fig 1, a very thin layer of bark was cut off. This figure shows the canker spreading almost equally in all directions from the point of inoculation. The dark line of cork cambium which usually surrounds cankered areas is noticeable here. In Fig. 2, still more bark has been cut off. This shows the canker spreading longitudinally in the layers adjacent to the cambium.

FIG. 1. Cacao stem showing canker produced by inoculation.

FIG. 2. Cacao stem showing canker produced by inoculation.

Description of Plate XIV.

FIG. 1, shows a small pod which shrivelled up and died as a result of the girdling of the stem by canker produced by inoculating the stem with Phytophthora. The point of inoculation is shown by a slight depression near the lower part of the stem on side opposite to pod. Fig. 2, shows a pod, almost full grown which became rotted as a result of an inoculation made in the tree at a point (shown by arrow) about 1½ inches above the cushion. Inoculation was made on February 11 with a pure culture of Phytophthora obtained originally from cankered bark. Photograph was taken on Feb. 25. The sporophores of Phytophthora can be seen on the diseased surface of the pod. Fig. 3, shows same stem with bark removed. Canker can be seen spreading in all directions from the point of inoculation.

PLATE XIV.

Fig. 1. Black rot of pod produced by inoculating stem.

Fig. 2. Black rot of pod produced by inoculating stem.

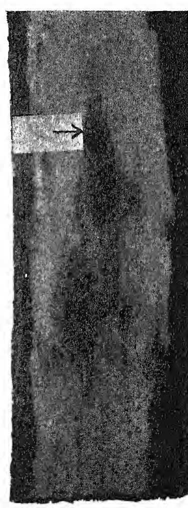


Fig. 3. Canker in stem and cushion produced by inoculation.

Description of Plate XV.

BOTH figures show canker in stem produced by inoculating pods with pure cultures of Phytophthora. In Fig. 1, the arrow shows the point at which pod was attached to stem. In this case the disease ran back from the pod into the stem, but did not spread much radially but ran longitudinally for some distance. In Fig. 2, the disease spread radially about the cushion in the outer bark.

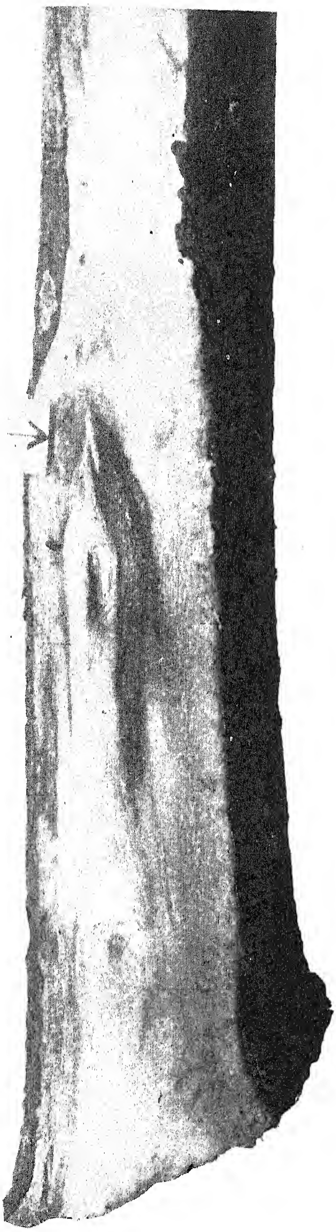


FIG. 1. Canker in stem produced by inoculating a pod.

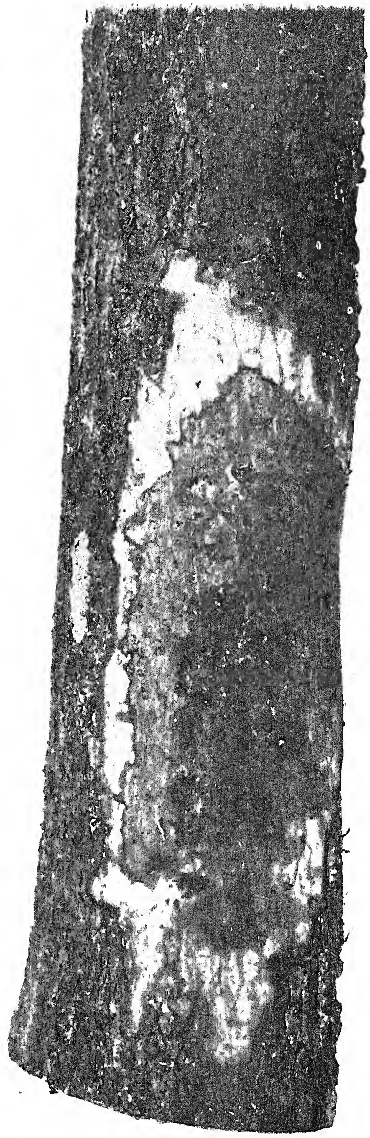


FIG. 2. Canker in stem produced by inoculating a pod.

Description of Plate XVI.

Fig. 1.—One picking from 500 sprayed cacao trees. The large pile contains 1,204 sound pods, and the small pile 73 "black" pods. Fig. 2.—One picking made at the same time from 500 adjacent unsprayed trees. The pile to the left contains 778 sound pods, and that to the right 262 "black" pods.

FIG. 1. One picking from 500 sprayed cacao trees. Black rotted pods in pile to the right.

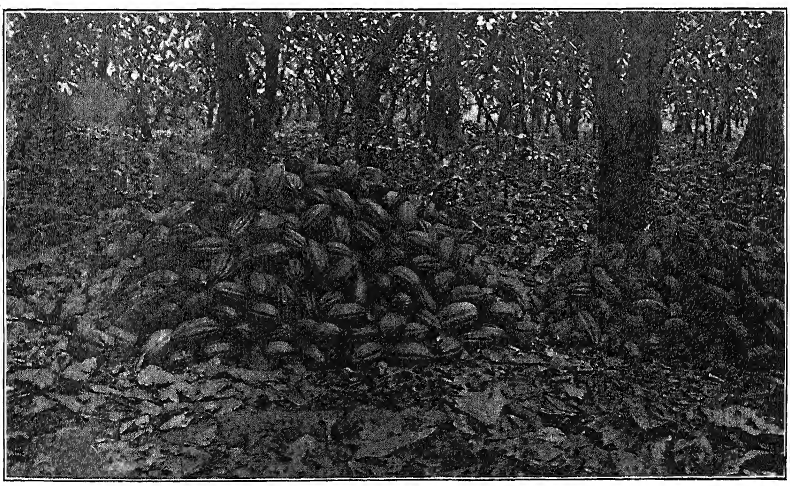
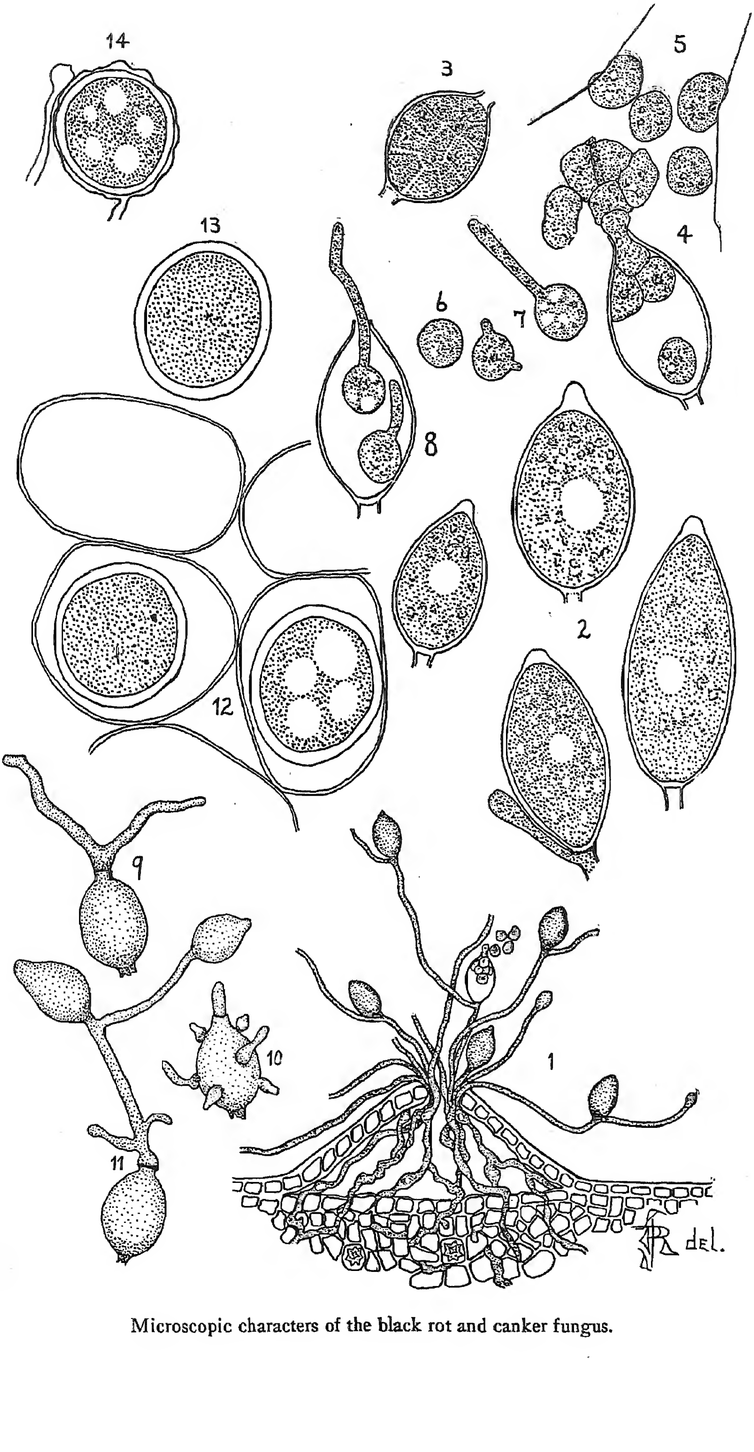


FIG. 2. Picking from 500 unsprayed trees. Black rotted fruit in pile to the right.

Description of Plate XVII.

MICROSCOPIC characters of the pod-rot and canker fungus.—1. A vertical section through a portion of diseased pod showing sporophores of Phytophthora. 2.—Mature spores of Phytophthora showing different shapes and sizes. 3.—A spore suspended in water showing contents beginning to divide into zoospores. 4.—Contents of a spore suspended in water escaping through opening at apex. 5.—Kidney-shaped zoospores. 6.—A zoospore which has lost its cilia and become spherical. 7.—Germinating zoospores. 8.—Two zoospores germinating within the mother spore wall. 9.—Spores germinating with a germ tube from the apex. 10.—Spore germinating with numerous germ tubes. 11.—Germinating spore producing spores. 12.—Resting spores within the rotted pod tissues. 13.—Single resting spore. 14—Oospore showing oogonium wall and antheridial branch.



Microscopic characters of the black rot and canker fungus.

"Cover and Forage Crops" Suitable to Trinidad.

BY

R. B. DICKSON.

COVER crops are used to prevent injury and loss to soils and to protect growing crops, and not for the products of the crops themselves. The term may be synonymous with green manuring crops, which are grown to enrich the soil in organic matter, until they are turned under.

The chief functions of cover crops are: —

i. to prevent the washing away of the top soil, especially on steep hillsides, by tropical rainstorms;

ii. to retain the soluble plant food instead of allowing it to be washed out through the soil;

iii. to do away with the expense of clean weeding or brushing, which is one of the heaviest bills the planter has to meet, by choking out grasses and other weeds.

Very many crops are used as cover crops, and they may be either leguminous or belong to other families of plants.

The following cover plants are now being experimented with at the St. Clair Station :—

1.	Bengal beans	1 plot.
2.	Velvet beans	3 plots.
3.	Soy beans	6 plots.
4.	Cowpeas...	2 plots.
5.	Beggar weed	1 plot.
6.	Crotalaria ..	2 plots.
7.	Indigo ...	1 plot.
8.	Earthnuts	1 plot.
9.	Sweet potatoes	2 plots.
10.	Japanese clover	1 plot.
11.	Bokhara "	1 plot.

Bur clover, (Medicago denticulata), woolly pyrol (Phaseolus mungo), and other plants are to be added as soon as possible.

At the present time Bengal beans, velvet beans, cowpeas, beggar weed and soy beans seem to be doing well.

1.—BENGAL BEANS.

The Bengal bean is one of the velvet beans, and was grown from seed kindly supplied by Mr. Gilbert, of Caroni. It seems to be doing better at present than a variety imported from the United States.

2.—VELVET BEANS.—(*Mucuna Utilis.*)

Some samples of Velvet beans from India and Mauritius sent by the courtesy of the United States Department of Agriculture, were only received a few days ago, and cannot at present be reported on.

The velvet bean (of Florida, U.S.A.), grown from imported seed, is a twining plant growing up to 50 feet in length, branching,

smooth and rather slender. Leaves, large 4″ x 3″, trifoliate. Flowers large, produced in racemes from the axils of the leaves, and generally purple in colour. Pods 3 inches long, blunt, slightly constricted between the seeds when mature and covered with a thick coating of dark velvety hairs (from which the plant gets its name). Each pod contains 3 to 6 globular seeds, $\frac{3}{8}$—$\frac{1}{2}$-inch in diameter.

The Florida bean is marked or splashed with dirty white colour somewhat similar to the castor bean, while the Bengal bean is jet black in colour with a white hilum, and the Mauritius and Indian varieties vary in colour, black white and splashed.

Climate.—In recent years the velvet bean has become an important addition to the field crops of the Gulf Coast States in the United States of America, and is well adapted to the climatic conditions of Trinidad and other tropical regions, reaching its maximum growth in climates with a very long growing season.

Soil.—It is well adapted to any well drained soil, and produces great yields on land containing sufficient moisture.

Planting.—It is planted in rows 4 feet apart, and 2 to 3 feet in the row. It soon covers the ground with a heavy mat of vines making a dense shade and choking all grasses. It is also an excellent preparation for sugar cane, Indian corn or cotton when fed on the land or used as a green manure.

It makes excellent hay and should be cut for this purpose when pods are formed, but before the bean begins to swell.

Yield should be 10 tons of green material, or 3 to 4 tons of hay per acre at the end of the season, or 40 bushels of shelled beans.

In the Southern States of America the velvet bean is used in orange, peach and other orchards. On poor land it is well adapted for the purpose, but only a narrow space between the tree should be planted and vines should be kept from climbing into the trees. In Trinidad and Tobago it can be equally well grown on the rubber and cacao estates and should help to keep down weeds, thereby lessening the expense of clean-weeding, brushing, &c. As a soil renovator it has few equals. It is not attacked by root nematode worms, nor is it subject to disease.

3.—Soy Beans.—(*Glycine hispida.*)

The soy beans now growing at St. Clair were imported from the United States of America.

The varieties grown are Yellow Mammoth, Hollybrook Early, Green, Brown and Black.

The soy bean is a strong, erect growing annual plant, native to China, Japan and Java, comparatively recently introduced into India and the United States of America. It is extensively cultivated in Bengal, Assam and Burma, and its cultivation in the United States is extending gradually.

The plant reaches 2–3 ft. high with many branches, and may be early or late maturing. It is covered with rusty hairs. The foliage is heavy and very thick, branching close to the ground.

The flowers are white to pink in colour and are borne in the axils of a single leaf. They produce 6–10 pods, 2–3″ long, containing 1–4 seeds roundish or oblong. The pods when ripe are dehiscent and expel the seed to some distance.

The root system consists of a tap-root connected with many lateral roots.

Climate and Soil.—The soils most suitable are light clays, loams and sands. The soy bean withstands drought well and is not injured by heavy rain. It can be grown wherever Indian corn does well. It will not make such good growth on poor soil as the cow pea.

Planting.—If for grain—seed should be planted in rows 24″–36″ apart, and seeds dropped every 4″–8″ in the row, depending on the variety. If for hay-rows 12″–24″ apart and seed thicker in row. The beans grow rapidly and as soon as they reach across the row they prevent the growth of weeds.

Harvesting.—If required for hay or grain, they must be cut when the lowest leaves turn yellow or after the pods are well formed, care being taken that these do not split.

Yield.—The yield of grain is usually 12 to 20 bushels per acre. On poor soils the yield of soy beans will generally equal that of shelled corn.

The usual yield of hay is 1½ to 2 tons per acre and of green material 6 to 10 tons.

Uses.—Soy beans may be used as a grain crop, for hay or for green manuring or as a cover crop. The grain and hay may be fed to any animal. As a land renovator the largest varieties as yellow mammoth are best.

The soy bean is much used as human food in Japan, the beans being boiled and afterwards fermented. It contains a high percentage of protein and oil, and is now being imported into Great Britain where the oil is extracted for soap making, while the residual oil-cake makes excellent cattle food. This plant is relatively free from insect attacks, though at St. Clair nematodes are attacking the roots to a slight extent at present.

4.—Cowpeas.—(*Vigna catjang*).

The seed was imported from United States of America; 2 varieties are being grown, one the Iron cowpea (which is resistant to nematode root worms and wilt disease), and the other, the Wonderful or Unknown variety.

The cowpea is a native of India, but was introduced into the West Indies in the latter part of the 17th century. It was cultivated on the mainland of America somewhat later.

The plant is only of importance in agriculture in India, China and the Southern States, U.S.A., but its cultivation might easily be extended.

The cowpea is an annual plant varying in habit; some varieties are erect and others trailing. It is not a true climber, as it has no tendrils; leaves are trifoliate, flowers usually white or whitish purple. Pods generally of straw colour, sometimes purple or black, varying in length from 5 inches to 10 inches, and containing numerous edible seeds.

Climate and Soil.—The cowpea is native of a warm climate, grows reasonably well on a great variety of soils, given sufficient temperature and not too much moisture. They require a well drained

warm soil, and may be grown on land too poor for cotton or maize. With excessive rainfall the yield of grain is decreased.

Planting.—In the United States of America cowpeas are most often drilled between the rows of maize at the last cultivation, when the rows are 4 feet apart, or they may be broadcasted before the last cultivation. When grown alone they are either drilled in rows 24 to 36 inches apart or broadcasted. The latter requires more seed but less labour. If the crop is intended for hay, the seed is drilled thicker than when intended for grain. Cowpeas and soy beans can be grown together satisfactorily. The hay of such a mixture is better than that of either crop alone.

Harvesting.—The proper time to cut cowpeas for hay is when most of the pods are full grown and many of them ripe. At this stage none of the best hay varieties have dropped their leaves. Those varieties of an upright habit of growth are best for hay as Whippor-will, Unknown and Iron cowpeas.

In curing the hay, the cowpeas should be placed in small cocks or heaps, supported on small tressels or pyramids, to allow the air to circulate through them.

If seed is required, the peas can be gathered by hand when ripe or the crop cut and then threshed.

Yield.—Cowpeas will yield from 16 to 30 bushels of seed per acre, 9 to 12 tons of green vines per acre, and 1 to 3 tons of hay per acre.

Uses.—In India it is grown for its seed and used as a pulse. The grain is eaten either as flour or split peas and the green pods are plucked while young and eaten as a vegetable.

As a forage, green or dried, it is readily eaten by cattle and sheep, while the grain may be fed to all kinds of stock.

In the United States of America, it is at the present time the most valuable legume for the entire cotton belt. It is specially valuable in that it improves land by the addition of vegetable matter and of nitrogen which it obtains from the air.

In Louisiana, 3 crops of cane are taken, and the land in the 4th year is planted to cowpeas. The work stock are fed almost entirely on peavine hay or are grazed on cowpeas. This gives excellent results in succeeding cane crops.

Diseases.—The cowpea is susceptible to cowpea wilt disease and nematode worms, to both of which the Iron variety is immune. This is well shown by 2 adjoining plots at St. Clair where the Wonderful pea is attacked by nematode worms, while the Iron is free from them.

5.—Beggar weed or Florida Clover.—(*Desmodium fortuosum.*)

The seed was imported from United States of America. The plot grown is doing well and this appears to be one of the most valuable crops now being experimented with at St. Clair.

It is a strong upright branched annual plant grown in Florida, (U S.A.) for hay, forage or cover crop. It reaches a height of 4 to 6 feet. The seeds are small, yellowish, flattened, resembling red clover. It is closely related to Japan clover, but is much larger and its pods are many jointed. It is native to the West Indies, Jamaica and

Florida, U.S.A. It belongs to the same genus as the wild Trinidad plant known as "Cousins," common all over this Island. Florida Beggar weed is the only cultivated plant of the genus.

Climate and Soil. It is a tropical or sub-tropical plant and likes rich, moist sandy soils.

Planting.—10–12 lbs. seed per acre if broadcasted are required or 5 to 6 lbs. if grown for seed. If sown thinly it becomes woody and is of little use for hay or as a cover plant. The seed must not be buried deeply, and if planted during the rainy season need not be covered at all. It reseeds itself without fail, when once established, unless seed development is prevented by too frequent cutting.

Harvesting.—If cut for hay, this should be when plants begin to flower, at say 3 to 4 feet high. After two cuttings it should be allowed to mature seed for the next crop.

Yield.—One to two tons of hay per acre for each cutting. The hay is easily cured.

Uses.—As a cover crop for orchards, cacao and rubber plantation it has no superior. It grows well, gathers nitrogen from the air and is not attacked by nematode worms.

As forage it is relished by all stock. It is rich in protein, of about same value as red clover.

6.- Crotalaria.

Two species of Crotalaria are grown at the Experiment Station for purpose of seed production, as well as for cover crop experiments. These are *C. striata* and *C. verrucosa.* The former is a woody shrub with stiff spreading branches and grows to a height of some 8 feet and is therefore unsuitable as a cover crop.

C. verrucosa is a much smaller plant, growing 3 to 4 feet high. It is not woody and should make an excellent cover plant. The pods of *C. striata* are about 1½ inches long, and black or dark brown in colour, containing about 30 to 40 seeds of a pale cinnamon brown colour, while those of *C. verrucosa* contain about 6 to 10 seeds of a larger size of a pale yellow brown colour.

7.—Wild Indigo.—(*Indigofera truxillensis.*)

The seed was obtained in Tobago and has only lately been sown. This plant grows 3 to 4 feet high and seems suitable for use as a cover or green manuring crop, though its lack of dense foliage makes it inferior to cowpeas and velvet beans for this purpose.

8.—Earthnuts.—(*Arachis hypogea.*)

This plant is also known as peanut, groundpea, pindar or goober. The seed was obtained locally. It is extensively cultivated in the United States of America, West Africa and West Indies.

It is supposed that earthnuts were introduced into the United States of America from Africa by means of the slave ships, as these "nuts" were largely used as food for the slaves during the voyage, but several allied species of plant are natives of Brazil, so that South America may also claim to be the natural habitat. The product is not really a nut but a ripened pod with edible seeds, of a plant like the pea.

The peanut is an annual of one foot or more in height, more or less creeping in habit. The leaves have two pairs of leaflets and no tendril. The male flower is showy, but the female flower is hidden, and more or less clustered, in the axils of the leaves. After pollination, the short thick stem which supports the lower portion of the flower elongates, and the sharp pointed ovary is thrust down into the soil, where the pod develops. If the ovary does not enter the soil, no pod is formed.

There are 2 main types, one which furnishes the peanut of commerce, requiring a long season, and the Spanish peanut which matures in about 3 months. The pods of the latter are smaller, and the seeds fewer and smaller. This is one of the most valuable fodder plants suited to warm climates.

The Spanish peanut is the one usually grown for forage. Peanut cultivation has recently increased to a remarkable degree in India and West Africa. The peanuts are chiefly exported to France.

Climate and Soil.--The soils best suited are sands or sandy loams. This plant will thrive on any soil except low wet lands. The climatic conditions required are a long growing season, plenty of sunshine and a high temperature without too much rain during the growing season.

Planting.—The seed should be shelled before planting. If unshelled seed is planted, a poor stand may result from empty pods, and it germinates more slowly.

The rows are generally 30 in. to 36 in. apart, and plants 6 to 12 inches in the rows, depending on the variety and soil fertility.

About ½ bushel of seed is required per acre, (shelled peas).

Harvesting.—When required for hay the vines are pulled when the pods are half formed and made into hay in the same way as cow peas. The yellowing of the vines during the latter part of the season, indicates the ripening of the peas. If digging is too long deferred, the first formed peas are likely to start growing, especially if there is much rainy weather at that time. After digging, the vines are placed round a central stake to cure, as soon as the leaves are thoroughly free from surface moisture. After picking the pods from the vines, they should be spread until thoroughly dry, and then put into bags.

The peanut vine is of great feeding value, similar to clover hay, where it has been carefully handled during the curing process.

Yield.—The yield ranges from 40 to 60 bushels peas, and two tons of hay per acre. The bushel weight varies from 22 lbs. to 28 lbs., the Spanish giving the greatest weight.

Uses.—It is much used for human food when roasted or salted, and also in the form of peanut butter. The peas are also crushed and the oil extracted and the residual cake used for stock feed. The best commercial nuts yield 42 per cent. to 50 per cent. of oil. The residual cake has as high a feeding value as cotton seed meal. The hay is also a valuable forage. The broken peas are used for fattening pigs, which may be turned into a field of peanuts to dig them for themselves. The vines form a fair cover crop, and green manuring material.

Diseases. -This plant is very free from disease and very few insects attack it. Plants may be sometimes destroyed by cutworms, and the nuts damaged by weevils if kept long after shelling.

9. Sweet Potato.—(*Ipomoea batatas.*)

The sweet potato is an edible tuberous root, probably a native of the West India and Central America. It is much grown in the Islands of the Pacific, especially the Philippines.

Climate and Soil.—A long growing period, with warm nights, plenty of sun and moderate rainfall are required. It likes a warm, well drained, sandy or sandy loam soil. It will grow on soils too poor for the production of many other crops.

Planting.—The crop may be propagated by cuttings or by sets taken either from the potatoes themselves or from growing vines. The plant may be grown on the level from 24 inches to 30 inches apart in each direction, or on ridges 36 inches to 42 inches apart and the plants 14 inches to 18 inches apart in the row. An acre of good land will support about 10,000 plants

Harvesting.—As sweet potatoes ripen, the vines show a slight tinge of yellow when ready for digging. For harvesting a large acreage, a sweet potato digger, or plough, fitted with two sharp rolling cutters, which cut the vines ahead of the plough, is used. Instead of an ordinary mould board, a number of rods slanting backwards from the share are used, to separate the potatoes from the soil. The drier the soil at the time of harvesting, the easier will be the harvesting and cleaning of the potatoes. They should not be exposed to hot sun or lie out all night. A dry atmosphere is required for storage. They may be placed in crates in some dry, well ventilated loft or kitchen. Care should be taken not to bruise the potatoes in digging and handling.

Yield.—From 100 bushels of tubers on poor land to 300 bushels on good rich soil, is the usual crop.

Uses.—The sweet potato is chiefly used for the table, and the demand for it is increasing. The vines if cured make a medium hay for cattle feeding ; in the green state their value is small. The tubers if sliced may be fed to cattle ; and hogs will root out the potatoes for themselves, thus saving cost of digging, if turned into the field. By combining peanuts and sweet potatoes in the proportions of 1 to 3 a splendid stock food is produced.

As a cover crop, the sweet potato may be used, but as it is not a leguminous crop it is far from being a soil improver. For best returns very heavy dressings of manure are required. The vines if forked in decay completely, thus adding very little humus, and continuous cropping results in very decreased yields.

Sweet potatoes contain about 20 per cent. to 24 per cent. of starch and sugar. Alchohol has been prepared from them, but so far the process has not been carried beyond the experimental stage. Starch has also been prepared on a small scale in the United States.

Diseases.—The crop is fairly free from insect attacks, though cutworms and the sweet potato borer, cause some injury in the United States of America From fungous diseases, the greatest loss occurs during storage, but black-rot may effect the crop at any time. A rotation of crops is the best preventive against disease.

10.—Japan Clover—(*Lespedeza striata*).

The seed grown was imported from United States of America. This plot had to be resown so that nothing can be said as to its value at present.

This plant is supposed to have been accidentally introduced into the Southern States from Eastern Asia about 50 years ago, and has spread rapidly.

It is an annual leguminous forage plant with stems much branched, reaching a height of 20 inches to 30 inches on good soil. The flowers appear singly in the axils of the leaf, pink or purple in colour. The leaves have three leaflets. The pod is small, and is divided by one or more joints. The seed is sold commercially in the pod.

Climate and Soil. —It is well adapted to tropical and subtropical countries, as it requires warmth and a long growing season. It prefers a moist but not wet situation. It will grow on the poorest soil, but does best on rich calcareous lands. It spreads rapidly, and prevents washing of the soil, and on thin soils it grows prostate, forming a dense growth. In sandy land during drought it suspends growth.

Planting.—It is broadcasted during the rainy season at the rate of 10 to 20 lbs. per acre.

Harvesting.—The plants should be cut for hay when in full bloom. If seed is required the crop should be left until most of the seeds are ripe. If a permanent stand is required it will re-seed itself, year after year, which makes it a very economical cover crop.

Yield.—It gives 1 to 1½ tons hay per acre.

Uses. —It can be used for hay, pasturage, green manuring or as a cover crop.

The feeding value is fair but less than cowpeas. Stock must however acquire a taste for it.

It is a valuable soil renovator, as it is a leguminous crop and the roots strike deeply into the ground, thus aerating the soil. It forms a vigorous growth, crowding out grasses and other weeds. It is not troublesome on cultivated land.

Diseases.—It appears to be free from the attacks of insects and fungi.

11. Bokhara or Sweet Clover.—(*Melilotus alba.*)

The seed sown at St. Clair was imported from United States of America. This is a biennial leguminous plant, grown in the Southern States of America as a green manuring crop, and found occurring there as a weed.

The Melilotus is an erect branching plant three feet or more in height with trifoliate leaves and small white flowers in racemes. It resembles alfalfa or lucerne (Medicago sativa) until it begins to flower. It rarely flowers the first year. It has a bitter taste, but a pleasant odour when bruised.

Climate and Soil.—It will grow on thin shallow soils which are in a poor state of cultivation, but does best on soils containing an abundance of lime. It should not be grown on soils capable of producing good yields of cowpeas, velvet beans, etc. The climate of the West Indies should be quite suitable for its growth, but as the seed has only been recently planted no data are at present available.

Planting.—The seed should be sown broadcast at the rate of half a bushel per acre.

Harvesting.—The crop should be cut for hay when about 18 inches high. On poor land it will not be worth cutting the first year, but on rich soil two cuttings may be obtained. Two or three cuttings may be taken the second year.

Yield.—On rich soils it will give 1 to 2 tons of hay per acre in the first year from 2 cuttings; and 2 to 4 tons of hay the 2nd year, from 2 or 3 cuttings.

Uses.—It is chiefly valuable for green manure and as a cover crop. On account of its bitter taste stock do not eat it readily.

As a green manure it is of great value as the tap roots descend deeply and aerate the soil, and when the crop is forked in a large amount of plant food is available for succeeding crops.

Diseases.—This clover is but seldom attacked by insects and fungi.

12.—Bur Clover.—(*Medicago denticulata.*)

Seed of this clover will be obtained shortly from the United States of America and planted in one of the experimental plots at St. Clair. It is a native of the Mediterranean region and was introduced into the United States of America, where it is now widely distributed. It is an annual plant having twisted pods, the edges of which are armed with a row of barbed prickles. It somewhat resembles alfalfa, but is of a more spreading habit

Climate and Soil.—It flourishes best along coast lands where there is abundant rain and should be well suited to the West Indies. It thrives on any land with sufficient rainfall to germinate the seeds, and withstands drought and heat.

Planting.—It is sown at the rate of 15 lbs. of clean seed per acre. The pods or burs left on the ground will germinate without trouble.

Uses.—It is only used for pasturage and as a cover crop. It is of no value as hay. As a pasture crop it is generally grown in connection with Bermuda grass (*Cynodon dactylon*) so common on savannahs, &c., in Trinidad. It is not so nutritious or palatable as alfalfa, but is eaten well by stock, which fatten on the burs or pods.

As a cover crop it is very valuable as it continually reseeds itself, after being once established, and it may be also forked in as a green manure. For orchards it is recommended as being superior to cowpeas, as it requires less plant food.

Where the crops mentioned in this paper are grown for seed or hay the seed should be sown from October to December, so that the crop may be fit to harvest for either of these purposes during the dry season.

As it is unknown whether the bacteria necessary for the best growth of many of these leguminous plants are present in Trinidad soils, planters are advised not to sow large areas of any of these crops until further trials have been made by the Agricultural Department.

In an article, Number CCCXI, in the Kew Bulletin of 1893, entitled "Cacao growing in Grenada," the following account given by Rev. J. W. Branch of one of his practices may be of interest:—

"I find that it pays me better to keep a portion of my land in cane cultivation or some other fodder, not from the profit to be derived from sugar, but because it enables me to feed my stock: without this I could get no manure, and without manure I could get no cacao. I look upon my stock therefore as part of my working capital but people here, (Grenada), seem entirely to forget this. I very often hear people speaking of the hard work they are having to get their plantation "covered in" as they call it, but if they know what I know, they would find it more to their interest to keep one-fifth of their plantation in pasture lands and fields of fodder plants, and to keep several head of stock to fertilise the other four-fifths."

In these notes many references have been made to the Southern States of America. The climate of certain of these States, *e.g.*, Florida, Georgia, Mississippi and Louisiana is not dissimilar from that of Trinidad during the Spring and Summer months, the same damp heat prevailing. While frost occurs in the States during the winter months, the Summer temperature ranges higher; the rainfall is about the same as in Trinidad.

It is hoped that in the next copy of the Bulletin, photographs of the forage crops at St. Clair, and of similar fields in the United States of America, will be published.

In the preparation of this article the following works on agriculture have been consulted, and they should be referred to for further information on the various crops dealt with in this paper:—

Bailey's Cyclopedia of American Agriculture.
Hunt's Forage and Fibre Crops in America.
Bulletins of United States Department of Agriculture.
Division of Agrostology—Bulletin 2—Fodder and Forage Plants.

Farmers' Bulletins:—

102, Southern Forage Plants.
318, Cowpeas.
324, Sweet Potatoes.
356, Peanuts.
372, Soy Beans.

Tennessee Agricultural Experiment Station, Bulletin Vol. XI of 1898, Nos. 2, 3, and 4, Grasses and Forage Plants.

Carap Oil

BY

C. Harold Wright, B.A. (Cantab.), F.I.C., F.C.S.

"Carap Oil" or "Crab Oil" (Fr. Huile Carape), is obtained from the seeds of the "Carap," "Crappo" or "Crab-wood" tree, *Carapa guianensis*, Aubl., a native of the West Indies and Central America.

The oil is prepared here for local consumption by very primitive methods. According to de Verteuil (*Trinidad*, London, 1858, p. 272): "The seeds are gathered in June and July, boiled for six hours, then laid in heaps for eight or ten days, during which time they undergo a sort of fermentation; they are then broken, and the pulp they contain carefully taken out and kneaded into lumps of thick paste, each about 15 pounds. This paste is laid on boards slightly incurvated and inclined, and placed in a sheltered place, when the oil oozes through the mass, and runs into a vessel placed for its reception. The paste is carefully remoulded every morning and evening, so as to favour the disengagement of the oil. After 12 days, boiling water is poured on the mass, and a fresh quantity of oil of inferior quality is thereby obtained" At the ordinary temperature here it is a clear yellow oil with a faint vegetable odour and an intensely bitter taste. This latter character precludes its use as an edible oil, though it is used locally for many other purposes. "It is used as an embrocation against rheumatism. It is also the best remedy for the destruction of ticks which attack domestic animals" (de Verteuil, *The Agricultural Record*, Trinidad, August, 1899, p. 17). "The oil has considerable reputation as a liniment for dressing wounds on horses and cattle." (*Bulletin of Miscellaneous Information*, Trinidad, No. 27). According to Spon's Encyclopedia, "the excessive bitterness of the oil repels all insects, and it is therefore used for anointing, and for preserving wood. . . . . For the application to timber, the oil is mixed with pigments or tar." I am also informed that it is used as a hair-oil. It is stated to be used as a lubricant, but it would not be suitable for this purpose on account of its high acidity. (*See* analyses). It is however well suited for the manufacture of soap, and it is in this direction that its future possibilities lie.

The Carap tree is now being planted in the colony to a considerable extent for the sake of its wood, but it would, I think, be worth the planter's while to see if it would not pay to collect the seed for export. I am not advocating the planting of Carap trees for the sake of the seeds, but only pointing out that the seeds have some commercial value, which perhaps is not generally known. Nowadays there is a tendency for the price of many oils used in soapmaking to

rise, owing to the demand exceeding the supply. The deficiency is made up by using other less known oils. In this way new industries have been created, as witness the case of palm oil; this oil originally prepared by the natives of the West Coast of Africa for their own use is now extensively used in the manufacture of soap.

Whether it would pay to collect and export the seeds remains to be seen. The oil from another species of Carapa, *C. grandiflora*, Sprague from Uganda is stated by Lewkowitsch (*Analyst*, Vol. xxxiii, No. 386, p. 184) to be worth £24 to £25 per ton. The value of the seeds depends on the use that can be made of the press-cake. The seeds of the Carap species are all intensely bitter and the press-cake could therefore only be used as manure. If so, its value, according to Lewkowitsch, would be £2 per ton, and the kernels would be worth £5 to £6 per ton These figures, of course, only apply to *C. grandiflora*; unfortunately I have not similar details with regard to *C. guianensis.*

A small sample of Carap oil was sent to the Imperial Institute by Mr. Henry Caracciolo, of St. Joseph, and was forwarded for chemical examination to Mr. W. H. Deering, Principal Assistant Chemist of the War Department (*Imperial Institute. Technical Reports and Scientific Papers*, 1903, p. 135). Deering's analytical results are given in Column I in Table on p. . In Columns II and III are given the constants of two Carap oils I have analysed here; both samples were purchased locally, and are presumably the oil from *C. guianensis.*

The oil from *C. grandiflora*, has been examined by Lewkowitsch (*Analyst*, Vol. XXXIII, No. 386, p. 184). The oil was prepared from a consignment of nuts sent from Uganda by Mr. Dawe of the Forestry Service. The good kernels contained 30·26 per cent. of oil, and were pressed in a hydraulic press at a pressure of 150 atmospheres. The cold pressed oil and the hot pressed oil were examined separately and the results are given in the paper. "The colour of the cold pressed oil was almost white, with a tinge of pale yellow. At the ordinary temperature it solidifies. The hot pressed oil is much darker in colour and remains solid at the ordinary temperature."

Lewkowitsch (*Analyst*, Vol. XXXIV, No. 394, p. 10) has also examined the oil from *C. procera*, D.C.; the seeds being obtained from Sierra Leone. The sound kernels yielded by extraction with ether 57·26 per cent. of oil; while the yield of oil by cold and hot extraction at a pressure of 150 atmospheres was 46 7 per cent. In the paper are given the analytical data for both the cold and hot pressed oils.

The oils from all the species of *Carapa* seem to be extremely bitter. The oils examined by Lewkowitsch resemble the Carap oils examined by Deering and myself in general characters. The chief difference lies in the iodine value. Judging from the meagre data available the iodine value of the oils from *C. grandiflora* and *C. procera* seems to be higher than that of the oil from *C. guianensis.*

TABLE.

	I.	II.	III.
Specific Gravity at $\frac{40°C.}{40}$	...	0·9149	...
Specific Gravity at $\frac{15·5°C.}{15·5}$	0·9225	0·9249[3]	0·9211[4]
Acid Value ...	22·6	27·5	19·4
Saponification Value	195·6	197·2	196·1
Iodine Value ...	65[1]	67·7	58·5
Reichert Meissl Value	2·2[2]	3·8	3·6
Unsaponifiable matter	...	...	1·16

1. Calculated by Lewkowitsch from the bromine value 41.
2. Calculated by Lewkowitsch from Deering's analytical data.
3. Calculated from Specific Gravity at $\frac{40°C.}{15}$ = 0·9090 by the author's method (*Journ. Soc. Chem. Ind.*, Vol. XXVI, 1907, p. 513.)
4. Calculated from Specific Gravity at $\frac{27·6°C.}{15·5}$ = 0·9133 by the author's method (*loc. cit.*)

Since writing the above I have come across an article in *The Bulletin of the Imperial Institute,* Vol. VI, 1908, No. 4. After referring to Lewkowitsch's analyses of the oils from *C. grandiflora* and *C. procera,* mentioned above, it is stated that "the value of the kernels would depend on their richness in oil. . . . . . The oil content can be considerably enhanced by drying the kernels in the sun before shipment, and this will also render them less liable to become mouldy during transit. It should be understood that the nuts should be decorticated before shipment, as the kernels only would be readily saleable here."—(p. 364.)

Notes on some Insect Enemies in Tobago

BY

P. L. GUPPY.

In connection with my recent visit to Tobago (14th to 24th February), I made the following notes on some insect pests which came under my observation :—

Adelphi and *Concordia* were visited about 3 miles from Scarboro', where the young Cacao and Castilloa appeared quite free from any pests, except for "parasol" ants which here as elsewhere, appear to give a good deal of trouble in Tobago.

COTTON STAINER.

The cotton stainer was very abundant, at the well known cotton plantation of Mr. Thos. Thornton at the *Grange*, Western end of Tobago, and would have done much serious damage if not kept in check by the persistent daily efforts of Mr. Thornton who was kind enough to show me round both cotton and tobacco fields. On the former there were boys at work collecting stainers in large calabashes half filled with crude petroleum into which they shook the bugs. This process has been going on for months past and still they appear in great numbers, though I am glad to say, by this, and several other methods, Mr. Thornton has managed to keep them within bounds.

In the course of our discussion on the subject of this pest we considered the practicability of adopting one or two additional methods of treatment for keeping them in check.

Mr. Thornton has not only used the methods best adapted to local conditions, but has also introduced ingenious ideas of his own from time to time, and we hope the results of these additional experiments will be satisfactory.

TOBACCO HORN WORM.

The tobacco field looked splendid and the cultivation was as clean as tobacco cultivations should be. There was only one pest to be accounted for here, and that was the "horn worm" which grows to a large size, about 3½ inches. As I walked along the rows of plants, which had all been topped, eggs and young larvæ, or both were frequently found. Mostly a single egg is laid on the underside of each leaf, the lower leaves being selected, not the younger ones at the top. The eggs are oval in shape, translucent, shiny, pale green, and can be easily detected as soon as the eye is trained to look for them, so that it is possible to have them removed before they hatch. These "horn worms" may be found at all times of the year from my experience in Trinidad. In this field they were found in all stages from the egg to a few almost full grown caterpillars that had escaped detection by the searchers. This caterpillar or "worm" is pale green with 7 oblique white lateral lines, commencing at the 4th segment, and the seventh ending at the base of the tail or "horn" which is pink. Spiracles black. They feed from the underside of the leaves, at first by eating holes, or at the edge, when they become larger the entire leaves are consumed. The large caterpillar may be seen on the midrib of a leaf from which it feeds as far as it can

reach on either side, as on account of its weight at this stage, any other portion of the leaf would droop and not afford a convenient footing. When alarmed they assume a sphinx-like attitude and remain motionless. They burrow under the soil when full fed to turn no chrysalids. These caterpillars have been successfully checked by growing from seed and planting out with the tobacco an occasional plant of Datura sp. or "wild tobacco," of which we have one well known as "Belle de nuit," with large pendant, trumpet shaped white flowers. Drops of poisoned honey or sirup placed within the flower will attract and kill the dusk-flying moths in numbers before they lay their eggs. Cobalt is recommended as having been effectively used for poisoning the moths in the Philippines by G. E. Nesom, Director of Agriculture there.

It is only by carefully searching each plant and removing the eggs and worms by hand that is perfectly certain of results, and this should be done at least twice a week.

A useful friend of the planters is a small parasitic fly which lays its eggs on the horn worm—these eggs produce small maggots which live inside the worm and when full grown they come to the surface and spin white cocoons outside the body in a thick cluster and look like cotton wool. Worms with these cocoons have already done all the damage they can do, and should not be killed, as the parasites might be destroyed before hatching, they should be left alone so that the flies might emerge and attack other worms.

Tobacco Bud Worm.

I did not find any trace of the "bud-worm," which is such a pest in Trinidad, and which on our plot at St Clair has played havoc with the young leaves at the top of every plant. Experiments are now being carried on for effectually dealing with this pest under local conditions, and I hope it will be kept out of Tobago.

Coconut Blight.

At King's Bay Mr. Reid took me around and shewed me coconut trees affected by "blight." This disease appears here and there among the healthy trees and certainly gives cause for alarm lest it should spread more rapidly at some favourable season. So far it seems to attack only the trees between 4 and 6 years old, the lower branches gradually dying off first, the crown of the tree remaining healthy to the last. One of the trees that was too far gone to treat by "firing" was cut down for my observation and several "gru-gru" worms were found in all stages, and a few beetles had got into the tunnels made by the worms. It would seem that the beetles come to lay their eggs after the trees are affected with disease, and I should think that they would merely hasten the decay of the trees and are not the primary cause of their destruction, nor is it through their agency that the disease is caused. There seems to be little doubt that this trouble arises from a leaf fungus and "firing" the trees seems effective in many instances if taken in time. Mr. Reid has taken every precaution and care in his methods of cultivation so that he naturally feels very mystified at the appearance of this disease among his healthy young trees. Fortunately so far there have not been many trees attacked.

On my way back from Roxboro to Scarboro I stopped and examined some coconut trees at Studleigh Park that grew near the

sea beach, among them was a batch of three close together that had died of the "blight," and as their leaves would overhang and touch one another when alive, it seems that there is danger in neglecting infected trees, especially where the trees are planted closely. The trees surrounding these three diseased ones were some way off and all quite healthy. I have observed that there is a tendency for 2 or 3 trees close together to be infected, although it often happens that a solitary one in the midst of healthy surroundings shows signs of disease, however as this is now being investigated by the Mycologist, who is dealing with a similar complaint in Trinidad, his recommendations will be given as soon as his investigations are completed.

Castilloa Blight.

At Roxborough Castilloa trees between 2 and 4 feet high were pointed out which had suffered from the attacks of the "Akee" fringed scale (*Asterolecanium pustulans Ckll.*) which is common in Jamaica, and is fairly prevalent in many places in Trinidad. They are very thickly packed together around the tops of the young trees, small round scales, about the size and shape of a pin's head, greenish yellow with a pink fringe, they are found not on the leaves, but on the twigs and stems. It is quite a pernicious species. The tops of these young trees infested with this scale, had died off completely and a fresh side shoot was thrown out, which was also attacked in some instances and died off as well. Castilloa plants of this size are easily replaced, so it would be as well to cut down and burn, the trees thus affected, or cut away the portion covered with scales, and spray the rest of the plant as a preventive against the spread of this pest.

Spray with 1 lb. lime-sulphur to 20 gallons water.

Cocoa Thrips.

At some places I visited there were traces of Thrips on Cacao trees, and in the same way as in Trinidad, they are to be found on the cashew trees, but only in small numbers so far as I could ascertain. Both cacao and rubber looked healthy, and as in other places in Tobago, were planted together and doing well. Here and elsewhere information was required as to the best method of tapping rubber trees, and at the high prices ruling for the product, it was thought that even the lives of the trees might be sacrificed if all the latex could be obtained.

Tobacco Flea Beetle.

At Belmont in a tobac o field recently planted out the "flea beetle" was very plentiful. This is well known as one of the worst pests of the tobacco planter. The "flea" beetle is very small and black, almost microscopical in size, it has powerful hind legs which enable it to skip away somewhat like a flea. These beetles are generally more active in the mornings and afternoons, and eat numerous small holes in the leaves. Clean cultivation is absolutely necessary, and all grass and plants around the fields should be cleared away, especially solanums, (Egg-plant), tomatoes, sweet-potatoes and such like. Arsenate of Lead had been proved very effective in checking this pest, and is best used in the seed-bed in strong proportions, 8 to 10 lbs. to 50 gallons of water. In the fields it should not be used stronger than 4 lbs. to 50 gallons of water.

The plants should not be sprayed within two weeks of harvesting, so that the traces of arsenate of lead left on the leaves might disappear.

In an interview with Mr. Cheeks (who is now making cigars and cigarettes, &c.), on his experiences in tobacco growing, he informed me that he had destroyed large quantities of beetles by means of a bon-*fire* at night, swarms of them had settled on his tobacco plants and being attracted by the blaze, flew into the flames. These may be the same species that were reported from various places as having eaten up all the mango flowers last season, and appear at certain times in vast numbers for a couple of nights and then disappear again for months. I was unable to obtain any specimens of these, but hope that their next appearance will be recorded and specimens forwarded with data.

Mealy Bugs.

Mr. Drysdale near the "Fort" reported that his cassava was suffering from "blight," so I visited his plantation and found a very prevalent "mealy-bug" cultivated by ants, had attacked the roots of the young plants and stopped their growth. He was recommended to "lime" his soil and change his crop for a couple of years, and then replant from healthy stock obtained elsewhere.

Figures of the pests treated in this report, with specific articles dealing with each, will appear from time to time in the *Bulletin*.

Thrips may one day become troublesome in Tobago, and a full and detailed account is being prepared by Mr. Urich, the Entomologist, with illustrations, showing the nature of the damage done by this minute insect pest, with preventive and remedial measures recommended.

Summary of Preventive and Remedial measures recommended.

Cotton.

Cotton is in very good hands at present, Mr. Thornton's systematic and careful methods of cultivation are exemplary. His preventive and remedial measures are as effective as it is possible to devise under the circumstances.

The cultivation of cotton by small proprietors, without a thorough and competent knowledge of dealing with the pests that attack it, might I am inclined to think be a source of danger to the intelligent cultivator as providing a place of incubation and refuge for both, diseases and pests.

Tobacco "Horn" Worm.

All natural food plants, such as pepper (*Capsicum*), and tomatoes should not be grown near the tobacco field. Look for the eggs, the eye can be trained to detect them. Handpicking as often as possible not less than twice a week, and traps such as poisoned flowers of the datura plants (wild tobacco) to kill the dusk-flying moths. If the worms become too numerous arsenate of lead may be used for spraying, 4 lbs. to 50 gallons water. Three sprayings should be sufficient. When the soil is being turned up, during the process of cultivation

after the crop has been harvested, the chrysalids may be found near the surface, as the worms go underground to transform, near the roots of the plants.

Tobacco Flea Beetle

This terrible little pest requires early and drastic treatment and spraying seems the only efficient remedy. Clean cultivation is absolutely necessary, grass and solanums (egg-plants), and all bush surrounding field must be destroyed. In the seed-beds use 8 to 10 lbs. of arsenate of lead to 50 gallons water, in the fields not stronger than 4 lbs. to 50 gallons. This remedy has been proved quite safe if two weeks is allowed between the final spraying and the harvesting of the tobacco, but it is best used in strong proportions in the seed-bed as a preventive and of course all traces would be removed when used at this early period. If heavy rains fall after spraying all traces will be removed much sooner, and it may be necessary to spray again if the plants are young and this pest still appears.

Coconut Blight.

This disease is now being investigated by the Mycologist, who is dealing with a similar trouble in Trinidad.

Castilloa Blight.

The young trees affected should at once be treated, either by cutting down and burning as a drastic remedy, or cut away the top and spray the balance of the plant as a preventive against the spread of this pernicious scale insect. Spray with 1 lb. lime sulphur to 20 gallons water.

Cassava Blight or "Mealy Bug."

A change of crop is recommended, and a selection, when replanting, of fresh and healthy stock. Liming the soil will do good after the crop is harvested. Continued replanting from diseased stock is often the cause of "blight" troubles.

Additional Notes.

Rats are much complained of as attacking both cocoa and coconuts—and rat virus is being used at King's Bay I understand with some success. The destruction of snakes, owing to the ignorance which prevails as to their usefulness, is no doubt partly the cause of this trouble.

The Carpenter Bird seems to have become too numerous and is adopting a vegetarian diet, which includes cacao pods, to supplement the insect diet; I should say a little thinning out of this species would do no harm. Birds of all sorts are very numerous.

Cocoa Beetle.—I did not hear anything of this beetle (*Steirastoma depressum*) which is very plentiful in parts of Trinidad, and is rather a troublesome pest and difficult to get rid of. The only way recommended and carried out so far, is the persistent daily search for them. It is hoped from experiments now being made that this costly method may be improved upon by the use of a suitable insecticide, by the use of traps and spraying.

15th March, 1909.

Economic Zoology in relation to Agriculture.

Part I.—Snakes.

BY

R. R. Mole, C.M.Z.S., (Sometime President of the Trinidad Field Naturalist's Club.)

Introduction.

The object of the following series of chapters on the ophidia of this Colony is to call the attention of agriculturists and all persons who are interested in the produce of the soil to the valuable services which these very much misunderstood and despised creatures render to them. Serpents by reason of their stealthy movements, peculiar appearance, and retiring habits have always been regarded with horror and dislike from the earliest times, and they have been repeatedly represented in mythological history as the ministers of the vengeance of the gods. Down through all the ages in every country serpents have been associated with evil and mystery, but the study of their habits by naturalists has shown that their presence in cocoa and cane field or orchard should be regarded more as a blessing than a curse. The most wonderful stories have been told of the habits of snakes and their powers, but singularly enough while the majority of these are absolutely untrue the facts of serpentine life are more curious than anything which imaginative ignorance has attributed to them. Trinidad is particularly rich in ophidians, possessing between thirty and forty species and in this respect differs from other West Indian Islands, none of which have, at the outside, more than ten or twelve kinds. Tobago, so far as can be ascertained, has only six or seven snakes, and they are all harmless.

Trinidad apparently possesses most of the serpents to be found in Guayana, and this circumstance is another proof, if any were needed, of the justness of geologists' theory that this Island was at one time united to the mainland. The proportion throughout the world, of really dangerously poisonous snakes to the non-venomous kinds is about as one to sixteen, and in Trinidad, so far as is known up to the present, as 4 to 35. Curiously enough although the writer has spent days and days at a time hunting snakes he has never encountered more than three poisonous ones in Trinidad and they were all of one species. One, after killing a dog was dug out of a bank, in the Mamural Valley, a second was encountered asleep in an open glade in the Tabaquite forest, and a third was a partly devoured specimen which had been slain by some forest animal at Guaico.

Contrast this with England where it is not at all unusual to find twelve or fifteen vipers in one circumscribed locality in the course of a summer. There used to be a spot near Aldershot where it was almost always possible to see one at a certain hour on any day there was sunshine and the writer used to visit the place in the

absolute certainty of finding a viper occupying the very same spot where he had captured one on the previous day. Of the ordinary grass snake it was not rare at Sheerness to see ten or a dozen in an afternoon's walk. Snakes are exceedingly local in their habits, but it is doubtful whether similar experiences to these could be obtained in Trinidad with its numerous species as compared with the three small snakes which inhabit the British Isles. It may therefore be taken as absolutely true that although there are so many species of ophidians in Trinidad, the individuals representing them are, comparatively speaking, few. From an agricultural point of view the snakes of Trinidad may very well be divided into four categories:—

(1.) Snakes which are altogether useful in that they devour rodents and insects which feed on cocoa and cane and fruit.

(2.) Snakes which destroy rats and squirrels but which vary their diet with other creatures useful to agriculturists, such as frogs, toads, and lizards.

(3.) Snakes which are rat eaters, but which are dangerous because of their venomous powers, and

(4.) Snakes which feed entirely on birds, frogs, toads and lizards, animals that are in the main all useful to the agriculturist as the destroyers of injurious insects, and which are therefore serpents which can be in no sense regarded as the friend of the cultivator.

All four categories are well represented in Trinidad, but, unfortunately, more usually than not, every snake is killed on sight. Of late years, however, a notion has been gaining ground that some snakes should be preserved as being useful inhabitants of the estates. But this discrimination is not as a rule wisely directed and it is a lamentable fact that the two most useful snakes in the Trinidad list are slain whenever seen, while others which are omnivorous, that is to say preying on every animal which they have the strength to overcome and the ability to swallow and which include in their menu all the useful batrachians and saurians and many insect-loving birds are occasionally spared for the partial good they do.

In the papers which are to follow an attempt will be made to describe with pen and picture the various ophidia of Trinidad in a manner which will enable anyone to know the different species when he sees them, and it is hoped that the result will be of benefit to the agriculturist in that it will lead to an increase in the number of the useful snakes and to a diminution in the hordes of rats and squirrels which at present levy such heavy toll on our cocoa, cane and fruit crops.

(To be continued.)

Eradication of Ticks.

BY

ROBERT NEWSTEAD, M. Sc., A.L.S. &c.

ROTATION OF CROPS AS A METHOD OF ERADICATING TICK-INFESTED PASTURES.

VARIOUS plans have been put forward in the United States of America for the eradication of the cattle tick by adopting a system of rotation of crops suited to the farms in certain parts of the country. Such a system, however, is quite impossible in Jamaica, where the pastures are laid down more or less permanently.

RESULTS OBTAINED BY BURNING PASTURES.

This was a question which was also submitted to the pen-keepers. The answers to this were, in a very large percentage of cases, that no beneficial results had been obtained by adopting such drastic measures, and, moreover, they nearly all agreed that the pastures so treated became more heavily infested, a few weeks afterwards, than before the grass was fired. But the contributors were certainly not unanimous in regard to this question. Two of them claimed that they had obtained "very good" and "very satisfactory results" respectively. Many consider the burning of pastures a ruinous proceeding, as weeds take the place of grass; while others, again, adopt the system more or less regularly, though the results so far as the destruction of ticks are concerned as apparently nil.

One correspondent is opposed to the burning of pastures, because of an extremely interesting discovery which he once made in reference to a silver tick (*A. cajanense*). He says that "in digging a pond, ticks, in crowds, turned up at a depth of 2 feet to 18 inches." He argues, therefore, that if ticks exist under similar conditions in pastures which may be full of cracks in dry weather that burning must be perfectly futile.

Natives, it would seem, are also opposed to the burning of pastures, because, in their opinion, fire causes ticks to breed more freely; and so firmly is this idea rooted in their minds that it is very difficult to get them to burn even those ticks which are picked off cattle.

Burning, of course, destroys all those ticks which are upon the grass or herbage; but it is quite evident that the majority of those which are protected in cracks or crevices in the ground or under logs of wood and under stones escape destruction; otherwise it is impossible that re-infestation could be brought about so rapidly afterwards. The explanation of the failure of fire in the destruction of ticks in pastures is, in the writer's opinion, undoubtedly due to the fact the ground had not been cleared of all stock for a sufficiently long period to enable the ticks to lay their eggs and for all the grass lice to hatch and disport themselves over the herbage,

thereby exposing themselves to the flames and ensuring complete extermination. To obtain thoroughly satisfactory results in the burning of tick-infested pastures, fire should not be applied until the eighth week after the removal of the stock ; and it is scarcely necessary to add that this should be done in the dry season, and none but clean cattle or "horsekind" should be turned into the pasture afterwards. It was suggested by one correspondent that in his opinion "the huge full-grown ticks which fasten on the 'frogs' which are found in great numbers at night in burnt pastures," may be the cause of the re-infestation of grazing land. The tick in question (*Amblyomma dissimile*) is not of any economic importance to the pen-keeper, as it does not attack his stock ; and, moreover, it does not, so far one could gather, occur in sufficiently large numbers to cause any appreciable annoyance to man or his domesticated animals. Further information regarding this tick is given in other parts of this Report (pp. 445, 446).

APPARATUS.

The terms "sprays" and "washes" are practically synonymous, as the agents used in both cases may be identical in composition. But tick-infested cattle must be treated according to the existing conditions or size of the herd. Small owners need go to no expense in the purchase of apparatus, as washes can be applied with a suitable brush, a piece of cloth, or a bundle of tow ; but for larger herds the pen-keeper will require either a spraying apparatus or a dipping tank. There are numerous forms of spraying machinery on the market, which for the most part are rather costly. For experimental purposes we used a Stot's Syringe fitted with one of their fine nozzles and a Cooper's "Bucket Spray Pump," kindly furnished by the inventors. The syringe proved by far the more convenient apparatus ; it was, moreover, extremely economical, there being practically no waste of material. By its use, also, the spraying was carried out expeditiously, and the movements of the animal could be much more easily followed than with a heavier piece of apparatus. The Stot's syringe or hand sprayer costs 10/6d. (f o.b.), the Cooper's spray pump, 28/6d. (f.o.b.) The best form of brush for liquid washes is the kind used for grooming horses, known technically as a "body-brush" A native-made brush, in general use in the island, is prepared from the fruit stalk of the coconut palm; it forms an excellent apparatus for applying thick tar and oil preparations, but is quite unsuitable for the more mobile washes.

The use of Dipping Tanks.—This is undoubtedly the most efficacious means of treating tick-infested stock, as has been abundantly proved in other parts of the world. Unfortunately, dipping is out of the question in some localities owing to the scarcity of water at the time when stock most require dipping. But there are certain parts of the island where public dipping tanks could be erected, and there are certain estates on which it would repay the owners to erect such a structure for their own use exclusively. This is a question, however, which the pen-keepers can best settle among themselves, and one also which has been brought forward recently by the Government and the Agricultural Society, through the generous offer of Messrs. Cooper and Nephews to supply the apparatus free of cost to the island.

Cattle Washes and Dips.*

Williams, in his official report, recommended as the cheapest and most reliable dressing for cattle ticks: "One pint of tar to three pints of boiled linseed oil, to be applied to all parts of the tick-infested skin," and added that "if one dressing be not sufficient a second should be applied in a few days." This formula, with various complicated modifications, has been in more or less general use for the last thirteen years. That this mixture or a modification of it is effective *as a local application* cannot be denied, but it is much too drastic in its effect upon cattle to be of any real service in the treatment of tick-infested animals.

There are also numerous other forms of washes in use, many of them prepared from materials which the settler may have at hand, but these, for the most part, are altogether too complicated and, in many instances, also too costly to be applied on a large scale.

Several proprietary washes and dips are also used; and in many instances with satisfactory results. In the series of experiments which are conducted by us at the Government Laboratory some of the more popular of these were tested, by spraying a number of tick-infested cattle. The results obtained gave a percentage of dead ticks varying from 5 per cent. to 65 per cent.

After prolonged experiments a most effective spraying wash has been evolved, consisting of a mixture of Cooper's "Dip powder" and Cousin's "Paranaph."† The former is a most effective preparation when used as a dip, but was not found sufficiently mobile to use as a spraying mixture, as it does not readily penetrate to the skin, especially in long-coated animals, and this was particularly noted in a young calf which was used for experimental purposes. Cousin's "Paranaph" is also a proprietary article, consisting of soap-paraffin and napthaline, devised originally for washing hops and fruit trees in Kent. The proportions of Cooper's dip used by us is the minimum strength recommended for use in dipping sheep and cattle; but in South Africa, where the "Bont Tick" (*Amblyomma hebraeum*) is very difficult to kill, the powder is used with safety half as strong again. The "Silver Tick" of Jamaica (*A. cajanense*), though closely allied to the "Bont Tick," does not appear to be so tenacious of life as its African relative. Realising the difficulty of obtaining the exact nature of the result of this compound upon "grass lice," which from their minute size are rendered almost invisible among the hair of the host, control experiments were made by placing masses of the young lice in muslin bags. These were completely immersed in the dip and afterwards suspended in the open air in a cool place and allowed to dry. Eighteen hours afterwards the "lice" were found still living, but on the third day every tick was dead; so that

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* This portion of the Report is contributed *in part* by the Hon. H. H. Cousins, M.A., F.C.S., Director of Agriculture, Jamaica, and his Assistant, Mr. J. E. Wortley, F.C.S.

† The formula of this preparation is as follows:—

1. Soft Soap (Chiswick Imperial)	...	55·6 per cent.
2. Water	...	21·7 ,,
3. Naphthaline	...	5·2 ,,
4. Paraffin	...	17·5 ,,

we may justly claim that this preparation is equally effective for all stages of cattle ticks. The exact formula of this wash is here given.

Paranaph 1 part, water 6 parts.
Cooper's dip 1 packet to 20 gallons of water.

One and a half quarts per head seems quite enough if applied properly. This preparation has proved not only effective in its immediate results, but a most persistent and adherent tick-destroying medium. The cattle which were sprayed by us, although left to graze in pasturage which was positively alive with "grass lice" for a period of five weeks, had at the end of that time scarcely a live tick upon them. We are sanguine, therefore, that the tick problem in Jamaica can be controlled cheaply and effectively with appliances readily obtainable and usable by any owner of stock; but the following conditions should be rigorously adhered to in syraying or washing cattle:—

1. The application of this mixture, which contains POISON, must not under any condition be applied at a less interval than fourteen days; and in our experience every five to eight weeks during the winter months is sufficient to keep the cattle practically free of ticks.
2. All sprayings or washings should take place in the early morning; and the cattle should be allowed to dry in the shade before turning out to graze.
3. If cattle have to be driven for any distance they should be allowed to cool before spraying. Driving both before and after should be quiet.
4. Cattle of all ages and also cows in calf may be sprayed. Cows in milk should have the lower portions of their udders sponged before milking on the first day of spraying.
5. The spray should be so finely distributed that practically none of the liquid drips off the animals treated. To avoid danger the operation should be conducted on a site devoid of grass.
6. All waste products and washings from the apparatus used should be thrown into the drains, or, safer still, into a hole in the ground and covered with a layer of soil.
7. All these instructions are applicable both for dipping as well as for spraying. *But in-calf animals should not be dipped a month or so before calving.*

We have every confidence in recommending this preparation, which, although containing arsenic is perfectly safe. The cattle treated by us did not suffer in the least; moreover, Cooper's dip and other arsenical preparations have been in use for several years in Africa, Australia and South America, and although thousands of cattle have been put to the test in all of these countries no loss has been occasioned when the regulations for its use have been strictly carried out.

In the conditions obtaining in Jamaica we do not consider that "dipping" is a practicable method; it is too costly, consumes too much wash, and is not without risk to stock. We advocate spraying with a wash, as above, possessed of such wetting power that a very fine spray will serve to wet and destroy all the ticks at one operation.

Conclusions.

1. That the tick responsible for the transmission of Texas-fever is the so-called Texas-fever tick (*Margaropus annulatus var. australis*), though experimental proof is needed to confirm this in the Island of Jamaica.

2. That ticks are most abundant during the dry season.

3. That ticks are dispersed from place to place chiefly by the host to which they are peculiar.

4. That rain or temporary flooding with water does not destroy ticks or their eggs.

5. That a relatively large number of young ticks will hatch and possibly survive for longer periods in dirty pastures than in pastures which are free from weeds and scrub.

6. That ticks cannot survive indefinitely and reproduce their species without access to a host.

7. That all natural enemies of ticks should be encouraged in every possible way, and that fowls should be kept in all cattle pens.

8. That in all cases where it is practicable the burning of pastures should not be carried out until the eighth week after the removal of all stock.

9. That tick-infested animals should be thoroughly sprayed or dipped regularly at intervals of five to eight weeks, or at less intervals if found necessary. Local applications being of little use in the destruction of cattle ticks, though useful in destroying those species which infest the natural cavities of the horse and mule.

10. That the effort to destroy the ticks must be a united one; no half-measures will serve: all must participate in the work.

11. That the evidence of those pen-keepers who have constantly waged war against this pest is that ticks, on their respective estates, are not nearly as troublesome as formerly. The writer very willingly bears testimony in support of this statement.

12. That the Island Government remove the duty from all materials used in spraying and dipping cattle.

[Reprinted from Reports of the 21st Expedition of the Liverpool School of Tropical Medicine, Jamaica, 1908–1909. Annals of Tropical Medicine and Parasitology, Vol. III, No. 4, November 1909.]

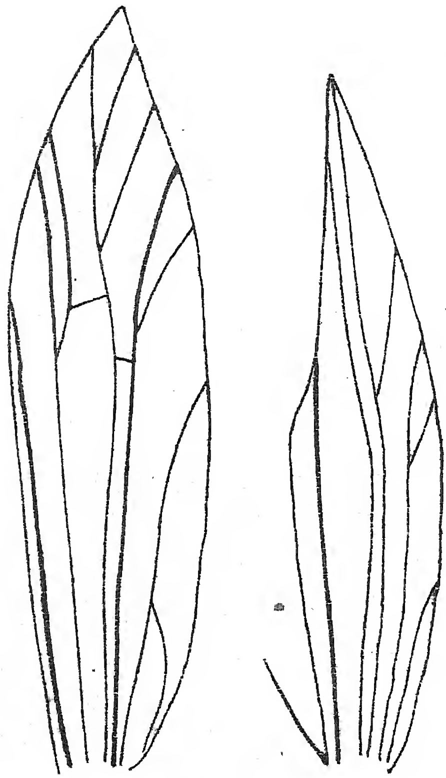


Fig. 1.—*Leucophasma carmodiella*, Busck.

Venation.

A New Tineid from Trinidad

BY

August Busck, U.S. National Museum, Washington.

Leucophasma carmodiella, new species.

Face, head and thorax yellowish white. Labial palpi moderate; second joint with long bristles especially towards apex; terminal joint shorter, reaching nearly to the vertex. Maxilary palpi small, but distinct, folded. Tongue rudimentary. Antennæ simple, silvery white. Forewings elongate; costa straight to apical third, thence deflected to the subacute apex which has the tendency to curve upwards at right angles with the surface of the wing as in the genus *Ereunetis;* this is probably even more the case in the living insect; termen evenly rounded from the slightly produced apex to the base. Ground colour, pure silvery white, but obscured over the greater part of the wing by overlaid golden, light ochreous, fawn and dark brown scales, so as only to appear in three longitudinal basal streaks, the upper of which is the longest and the broadest. At the end of the cell is an ill-defined light yellow round spot, surrounded by fawn and dark brown scales; costal edge above the upper basal white streak golden yellow; apical third of the wing somewhat lighter than the rest of the wing, whitish golden; costal cilia with alternating white and yellow tufts;—dorsal cilia darker, ochreous brown. Hindwings silvery white with a yellow sheen, cilia yellowish. Abdomen ochreous white. Hindlegs with long white tibial tuft, continued into a strongly contrasting, blackish brown tuft on the upper side of the first tarsal joint; rest of the joints golden brown.

Alar expanse: 16–17 m.m.
Habitat: Tobago Island, British West Indies.
Type, U.S. National Museum, No. 13142.
Cotype in British Museum.

I am under obligations to Mr. F. W. Urich, who has sent me this species with the following note on its life history, which he may eventually be able to complete:—"Bred from stem of a Cocoa tree, "that had died from some fungus (*Eutypa* sp.) The caterpillars "tunnel the wood like *Platypus* beetles, or possibly they take "possession of their tunnels. The pupa is quite near the surface "and is protected by a small cap, made by the caterpillar."

"In issuing as an imago the cap is pushed up and the pupa shell "remains sticking half way in the burrow. This particular piece of "Cocoa tree was sent from Tobago by Mr. W. E. Broadway, but I "have seen the same fungus in Trinidad."

The species is of extreme value and interest systematically as a means of the re-discovery of the peculiar genus *Leucophasma*, Walsingham, which has hitherto been represented in collections by a

unique type of the genus, *L. phantasmella*, Walsingham, described from Grenada, British West Indies, which is in British Museum in rather poor condition.

Lord Walsingham's general description (Proc. Zool. Soc. London, p. 155, 1897), though enabling an undoubted identification, needs nevertheless some modification; it states that the maxilary palpi are obsolete, while they are really present and folded; the face is not smooth, but loosely haired much like the head, and the neuration should probably be interpreted differently as reference to the figure, herewith presented, will show.

Mr. J. Hartley Durrant has kindly re-examined the type of the genus carefully for me, and agrees in these corrections as well as in the determination of the present species as congeneric.

The present species is amply different specifically from *L. phantasmella*, Wlsm., in ornamentation and in size, though of the same general habitus. The hairy first tarsal joints of the posterior legs are very striking and are not found in the type species, but neither Mr. Durrant nor the writer would consider this character of generic importance; structurally the two species are identical in their oval and pterogostic characters.

I take great pleasure in associating with this pretty and interesting new species, the first Microlepidopteron described in many years from Trinidad, the name of my esteemed friend, Professor P. Carmody, whose genial hospitality once greatly added to my pleasurable visit to Port-of-Spain, and under whose mature guidance the new Department of Agriculture of Trinidad has entered into an activity, which promises to further the purely scientific as well as the economic exploration of beautiful Trinidad.

Some fresh-water fishes of Trinidad and Tobago

BY

P. L. GUPPY.

AMONG the fresh-water fishes that I noticed when in Tobago there were three species that appeared to be plentiful and found in most streams—

"FRESH-WATER MULLET."

1. *Agonostomus, monticola,* (Bancroft).

This is the most active and noticeable species, it is very plentiful.

From their numbers it is clear they are masters of the situation in Tobago streams. The absence of "Sardines" (Tetragonopterus maculatus) struck me, as, in our Trinidad streams, this, and other species of Tetragonopterus ("Sardines") simply swarm, the "Mullet" being a shy and wary customer and not often seen, although in the streams along the north coast of Trinidad I have seen them fairly plentiful but not to equal the numbers that appear in Tobago. No doubt the absence of "Sardines" in Tobago would account for the large proportion of Mullet there. This species is found in the fresh-waters of the West Indies and Mexico.

It appears, on the authority of the British Museum, that there are three species of Agonostomus in the West Indies :—

A. microps.
A. percoides.
A. monticola.

"MILLIONS" OR "BELLY FISH."

2. *Girardinus guppyi* (Gunther).

The prettily coloured males, as in Trinidad, varied considerably in their markings and bright tints.

Male—Olivaceous, silvery below; a dark longitudinal stripe from eye to middle of side, and another on posterior part of body; usually 2 to 4 blackish spots, including one at each end of the posterior stripe; these may be accompanied by reddish spots, and other bright iridescent tints.

Female—Olivaceous, silvery below; without spots, or stripes, or any bright colours.

Whether *guppyi* is a variety, or distinct from *poeciloides* and *versicolor*, which occur in other West India Islands, would be interesting to ascertain, but as they have all been named by the British Museum authorities it would seem that there are three distinct species.

"SMALL GUABIN."

3. *Rivulus harti* (Boulenger).

I got some of these lively little jumping fishes in a small pool by the roadside not far from the Custom House in Scarboro'. They sometimes attain a length of 4 inches, but this is only where surroundings are the most favourable, more usually they are found 2½

inches in length. They always try to jump out of any vessel in which they are placed; if the sides are too high to clear at one leap, they can stick on with their fan-like tails and leap higher: in this position they often remain for quite a while stuck against the sides of any vessel that they are unable to get out of, and do not appear to suffer in the least from the considerable length of time they sometimes remain out of their natural element. This habit of leaping from pool to pool in the wet season enables them to get to considerable elevations and reach isolated pools that may contain mosquito larvæ, which the other fishes cannot reach, hence they are often the only fishes found in hilly places and inhabit streamlets quite a good way up Tucutche, nearly, if not quite half-way up to the top. They used to be seen together with G guppyi in the gutters of Port-of-Spain before the concrete drains were laid down, and may be found now-a-days in the "Dry River," Belmont; besides being keen on mosquito worms, they occasionally swallow a G. guppyi. Both these species are generally found together in the same localities, and in small pools where there would not be room for larger fishes to live, and often in very nasty water. At the mouth of tidal rivers, both these species of Cyprinodonts are able to stand the brackish, swampy water, where many millions of them must be consumed by the various sea-fishes that go up these rivers to feed at high water.

Colour of adult R. harti.—Olivaceous or greenish above; sides with green or blue longitudinal stripes alternating with series of dark red spots along the rows of scales; vertical fins usually orange; dorsal with 3 or 4 series of small dark spots on its basal part, sometimes with a narrow dark edge; tail often with a blackish ocellus, or eye-like spot, on the upper part of its base, spotted and with dark edge. Recorded from Venezuela.

There are more than 40 species of fresh-water fishes recorded from Trinidad, and I should say that at least half that number prefer mosquito larvæ to any other diet, when they can be got;--among them, the best known are:—

Cyprinodontidæ.

1. Girardinus guppyi—"Millions" or "Belly-fish."
*2. Rivulus harti—"Small guabin."

Characinidæ.

3. Tetragonopterus maculatus—"Pink-finned or common sardine."
4. „ guppyi—"Yellow-tailed sardine."
5. „ unilineatus—"Small sardine."
6. „ taeniurus—"Small sardine."
7. Chirodon pulcher—"Small sardine."
8. Curimatus argenteus—"Stout or silver sardine."
9. Corynopoma riisii—"Small sardine."

Cichlidæ.

10. Acara pulchra—"Small cascorob."

Nandidæ.

11. Polycentrus schomburgkii—"King cascorob."

* No. 2.—R. harti was formerly described as R. micropus (Gunther).

Specimens of the above were all taken over by me to England and landed alive and in good condition after a 30-days voyage in May, 19C6, except Nos. 4 and 10. When I went to see them a few months later they were all thriving and doing well in an aquarium; G. guppyi and P. schomburgkii had increased in numbers.

The above are figured and described in P.Z.S., Vol. 1-1906.

Notes and Comments.

Professor Carmody has been absent from the Colony for the past six weeks for the purpose of attending the Congress of Tropical Agriculture at Brussels, at which he read several papers.

On account of illness, Mr. Carruthers has been unable to complete his paper on tapping Castilloa rubber trees for this number of the Bulletin.

Mr. Guy St. Clair Feilden who has been appointed to act as Curator of Government House Gardens and Superintendent of the Experimental Station during Mr. Evans' absence took up his duties on the 10th May. After taking his degree of B.A. at Oxford in 1907, Mr. Fielden was engaged in botanical and horticultural work in Ireland.

In forwarding specimens of *Lachnosterna patens*, a leaf-eating chafer, Mr. W. H. Patterson of the Agricultural School, St. Vincent, writes as follows :—

"I enclose specimens of a beetle which last year appeared likely to be "disastrous to young leaves of cacao. The beetle comes out of the ground, "where it hides during the day, at dusk, feeds only on the young, newly "expanded foliage and retires to the ground between 9 and 10 p.m. Hand-"picking appears to be the best means of control for the imago though, "it can be caught to some extent by light traps. As many as seven hundred "have been collected in a few evenings from a small number of trees. The "pest has appeared again this month."

As far as we are aware this is the first time that this chafer has been found destructive to cocoa. It occurs in Trinidad, but has not been observed on cocoa estates.

As the Texas fever tick occurs in Trinidad we have reproduced Professor Newstead's valuable recommendations for the destruction of ticks which we hope will be of use to planters.

Mr. R. H. B. Dickson who is temporarily attached to the Department is engaged in the study of tropical agriculture. He has travelled extensively in South Africa and the United States. The plots of cover crops which he has growing at the Gardens are well worth a visit.

We have received from Mr. John J. Quelch, B. Sc., London, a copy of his Report on the Giant Moth Borer (*Castnia licus*). It is a report of investigations carried out during the past three months on the attack of this destructive moth in British Guiana. It forms a valuable contribution to our knowledge of the habits of the moths and describes for the first time the early stages of the caterpillars. Among the remedial measures the catching of moths is recommended and in connection with the natural enemies stress is laid on the action of rats, which play a considerable part in keeping down the numbers in Demerara.

In this issue we publish the first of a series of articles on "Economic Zoology in Relation to Agriculture." In these papers we hope to take up all the animals, with the exception of insects, which are friends or foes of the agriculturist. Mr. Mole has kindly consented to write the articles dealing with snakes.

Report of the Mycologist for the year ending April 30, 1910.

BOARD OF AGRICULTURE,
Port-of-Spain, Trinidad.

GENTLEMEN,

I am herewith submitting a report briefly covering the work which has been done along mycological and pathological lines during the past year, and containing plans and suggestions for the work which I wish to carry out this year.

Although I assumed the duties of Mycologist on April 15, 1909, neither a suitable laboratory room nor fund for the purchase of necessary apparatus was provided until after Mr. Carruthers' arrival, so that I was much handicapped in my work during the first six months of service and was obliged to spend much time simply in making field observations on the prevalence and distribution of plant diseases and in becoming familiar with the methods of cultivating and harvesting the various crops grown on the Island. With the acquisition of the room at the Experimental Station and the purchase of some much needed apparatus a laboratory has been fitted up, which is now serving the purposes of the work fairly well, but if mycological and pathological work is to become a permanent fixture in the Department of Agriculture more room and equipment will be necessary.

DISEASES OF CACAO.

On taking up phytopathological work in the tropics for the first time one is almost appalled by the great number of interesting problems awaiting solution, and it is difficult to select those of most importance. However, after making preliminary visits to a number of cacao, coconut, and sugar estates in the various parts of the Island and noting the fungous diseases present on each, I decided that the diseases of cacao were responsible for the greatest losses, and I have devoted the greater part of my time to the study of some of these diseases.

An examination of the literature shows that much confusion exists as to the causes of a number of the common cacao diseases. An endeavour has been made to clear up some of the doubtful points. Cultural and inoculation experiments have proved that the two most serious diseases here, the canker of the tree and rot of the pods, are both caused by the same fungus, a species of Pyhtophthora. This fungus attacks not only small pods, causing them to blacken and shrivel, but larger ones as well producing the so-called "black cocoa." From the pods the fungus grows into the cushion and spreads in the surrounding bark killing the tissue and causing the disease commonly known as canker. Numerous inoculations of both pods and bark have been made with several species of Nectria and other fungi which have hitherto been regarded as the causes of canker and pod disease but the results have always been negative. A paper on the canker and pod rot caused by Phytophthora is in course of preparation. A number of minor diseases of cacao are also under

investigation among which may be mentioned, die back, thread-blight root disease, anthracnose of pods and the chupon disease; these will be reported upon later.

Since the publication of Dr. Fredholm's translation of Dr. Van Hall's paper on the witch broom disease of Suriname a great many specimens of suspected witch broom have been sent to the office for examination but none of these have proved to be typical witch brooms such as destroy the trees in Suriname, and as was pointed out in the last number of the Bulletin there is no proof as yet that star blooms, indurated pods, "male" cacao and other abnormal growths which are commonly met with here are symptoms of the true witch broom disease.

Cacao Spraying Experiments.

Spraying experiments for the control of the cacao pod rot were started last July, and are now being carried out on three different estates located at Tumpuna, Sangre Grande and Williamsville. The results from these experiments have been uniformly successful and show conclusively that spraying not only reduces the rot of mature or $\frac{3}{4}$ grown pods, the so-called "black cocoa," but increases the yield as well by protecting the very young pods from fungus attack.

In the experiment at Tumpuna the trees were sprayed twice last September, and to the present time from 500 sprayed trees 1,608 more pods have been picked than from 500 adjacent unsprayed trees. Twenty-nine per cent. of the cocoa from the unsprayed trees was black while only 7 per cent. of that from the sprayed trees was black, as a result of this 2,125 more sound pods have been picked from the sprayed trees.

At Sangre Grande the trees were sprayed once in December and again in February. In the last four pickings 1,725 more pods have been gathered from the sprayed than from the unsprayed trees.

A bulletin giving the results from all the experiments, the mixtures used, the methods of applying the solutions, and the cost of application will be issued later on in the year. It may be mentioned in passing however that spraying cacao, if done thoroughly and properly pays, for it not only gives an increase in yield which more than compensates for the outlay in labour and material, but also protects the trees from canker infection through diseased pods, and controls various minor diseases such as thread blight, chupon disease, etc., which are found on almost every estate. Spraying also makes hand mossing unnecessary.

Diseases of Sugar Cane.

During the rainy season of last year a number of sugar estates were visited and an examination of various fields was made in order to determine if there was any connection between the root disease and the blight. As was reported at the September meeting of the Board no relationship between the two diseases was found, and though they sometimes may be found together in the same field either may occur without the other.

A fungus named by Massee *Septocylindrium suspectum* from material sent to Kew from the *Caroni* estate by Mr. Kay was frequently found on dead adult froghoppers, but whether or not it is

parasitic has not yet been determined. I hope to make some tests with this fungus during the coming rainy season to determine this point.

Diseases of the Coconut Palm.

The coconut diseases of the Island were reported upon by Stockdale in the latter part of 1908, and under the Plant Protection Ordinance the bud-rot and root disease were proclaimed as dangerous diseases, but so far as I know no steps were ever taken to enforce the Ordinance in regard to them. 'Spraying is impracticable as a means of controlling coconut crown and stem diseases on account of the height of the tree, so that rather drastic measures have to be depended upon to hold such troubles in check. Of the crown diseases undoubtedly the bud-rot is the most serious, and every means should be taken to keep it under control. In order to prevent this disease from spreading every tree affected with it, even if only showing the first symptoms, should be cut down and destroyed.

In the southern part of the Island the root disease, first described by Stockdale, has been responsible for the death of a large number of trees. This disease is complicated by the fact that the bud of affected trees frequently rots; whether this rot should be considered bud-rot or simply the last symptom of the root disease can only be determined by a cultural study of the bacteria associated with it in order to ascertain if the organism which causes the true bud-rot is present. The fungus causing the root disease has not been definitely isolated nor is the way in which it spreads from tree to tree clearly understood, so that perhaps the best methods of treatment or of control cannot yet be given. But the facts that the bud of trees affected with this disease frequently is killed by a soft bacterial rot which may be the same as the bud-rot disease, and that Stockdale has suggested as a cause of the trouble a fungus which fruits on the leaves of diseased trees, make it essential, as a method of safeguarding healthy trees, to destroy the buds and leaves of affected trees. Perhaps later, when both bud-rot and root disease are better understood some other method of control may be worked out, but at the present time the destruction of infectious material is the best known means of combatting these diseases.

The work of destroying diseased coconut palms for which you voted the sum of $500 in November last, has been pushed forward as quickly as was possible and to date about 8,000 dead or dying trees have been cut down with and expenditure of about $375. Mr. Plummer has had charge of this work. I think he will have completed the tour of the whole Island by the end of June, and will then start on a second round, if an additional sum of money will be granted for this purpose.

Until some better means of control of coconut bud-rot and root disease be learned I think it essential for the preservation of the coconut industry here that the present ordinance be enforced, or perhaps better, a new ordinance be made dealing with these diseases alone. Under such an ordinance, an inspector should be appointed, and I would suggest Mr. Plummer for the post, whose duty it would be to see that the ordinance was enforced.

The bleeding stem disease of coconut palms is prevalent in some parts of the Island. A similar disease is reported from Ceylon, where Petch has proved it due to the fungus *Thielaviopsis ethaceticus* Went. Petch's method of holding the disease is check by cutting out the diseased tissues and tarring the wound has been used here successfully on some estates.

A disease which may be called the little leaf disease is very common in some places. The leaves of the trees affected with this disease stand erect and never attain their normal length, but remain stunted and the leaflets are often crimped. The leaves become shorter and shorter as time goes on until finally the tree dies. Very occasionally a tree will outgrow this disease. Its cause is unknown. Petch has recently described a somewhat similar disease from Ceylon under the name of root disease.

The leaf disease of coconut palms though widespread here does not seem to be at all serious

Diseases of Bananas.

Three diseases of bananas and plantains are commonly met with in Trinidad. Perhaps the most important is the Gros Michel or Panama disease, the cause of which has not been definitely settled.

Dr. Erwin F. Smith of the U. S. Department of Agriculture in a paper read before the American Phytopathological Society at a meeting held in Boston last December, described a fungus belonging to the genus Fusarium which he isolated from diseased plants from Cuba. Inoculations with pure cultures of this fungus showed that it is evidently a parasite, but at the time of the meeting the inoculations had not been made long enough for the plants to show all the typical symptoms of the Panama disease.

McKenney who has studied the disease in Costa Rica and Panama also read a paper at the same meeting. He described the symptoms of the disease in detail but simply states that the cause "is in all probability a vegetable parasite."

Essed, working on this disease in Paramaribo has recently reported that it is caused by a fungus belonging to the "Ustilagineae probably in company with a member of the Chytridious order," and states that his figures will help corroborate his preliminary conclusions. His theory is rather an unusual one, and his figures do not clearly show characters typical of either order of fungi which he mentions.

Last November I isolated a species of Fusarium from diseased Gros Michel plants from the St. Joseph district and more recently the same fungus from some diseased plants from Suriname. As yet the results of my inoculations on healthy plants with this fungus are doubtful.

Another disease, especially of plantains which is common here is the Moko disease. As I have proved by a number of inoculation experiments this is unquestionably a bacterial disease. I at first thought that this and the Panama disease might be one and the same, but if the latter is proved to be caused by a species of Fusarium, it is evident that the two diseases are distinct.

A root disease of bananas caused by a species of Marasmius, which was reported upon some time ago by Mr. Hart has been quite severe the past year especially on the red banana.

Diseases of other Crops.

Among the diseases affecting crops of minor importance may be mentioned the anthracnose of mangoes and avocados; leaf-spot of cassava, leaf-mould of tomato, thread-blight of coffee, crotons, etc., and root rots of various plants.

Last year scarcely any mangoes suitable for shipping could be obtained on account of anthracnose, a disease caused by *Gloeosporium mangiferae* P. Hennings, a fungus which attacks not only the fruit, but the flowers and leaves as well. Several trees were sprayed at flowering time to control this disease and the fruit is now ripening and seems much freer from disease than it was last year. Trial shipments of sprayed and unsprayed fruit will soon be made. If an export trade of mangoes and avocados is to be worked up here it will be almost essential to ship only fruit which has been sprayed, otherwise the carrying quality cannot be at all guaranteed.

The leaf-spot disease of cassava is universal but can readily be cotrolled by spraying. Experiments are being tried to learn if more foliage cannot be kept on the plant by spraying and in this way the amount of starch stored in the roots increased.

The leaf-mould of tomatoes caused by *Cladosporium fulvum* Cooke, was controlled by the use of Bordeaux mixture on a few plants grown at the Government Laboratory last year.

The rose mildew which is quite common on some varieties at certain seasons has been controlled by the use of a weak lime sulphur mixture.

Collection of Fungi.

But little time has been spent in collecting and identifying fungi other than parasites as books dealing with systematic mycology are lacking and at present there is no available space in which a large collection can be kept.

Publications.

In the last number of the Bulletin of the Department of Agriculture, I published four papers entitled :—

Preliminary Report on Cacao Spraying Experiments,

The Relation of Black-Rot of Cacao Pods to the Canker of Cacao Trees,

The Witch Broom Disease of Cacao in Surinam,

The Bud-Rot of the Coconut Palm,

and in the March number of the Proceedings of the Agricultural Society a paper entitled :—

A Bacterial Disease of Bananas and Plantains.

Future Work.

I hope to be allowed to continue the cacao spraying experiments along the same lines as heretofore as the data obtained from these experiments are of great value in making general spraying recom-

mendations, and by carrying on the experiments in the same place for a series of years the cumulative effect of the spraying can be observed.

I should like to be able to devote the greater part of my time to the study of coconut palm diseases especially the root disease. It is important to prove definitely what fungus is the cause of this disease and to determine whether or not the bud rot which frequently accompanies it is caused by the same organism as that which causes the typical bud-rot disease.

If the fungus which has been found on dead froghoppers proves to be an entomogenous parasite field experiments with it on a large scale will be tried to see if it will aid in the control of this pest.

JAMES BIRCH RORER,
Mycologist.

May 15th, 1910.

Report of the Entomologist.

Board of Agriculture.

Gentlemen,

I beg to submit herewith a report covering my work for the year ending 31st March, 1910.

On my assuming the duties of Entomologist some time elapsed before the necessary apparatus was received and a suitable Laboratory equipped. To get a general idea of insect injuries to cultivation and the requirements of the different agricultural products, a considerable amount of travelling was performed.

The entomological features of the year under review are best discussed under the headings of different products.

Sugar Cane.

The chief pests of the sugar cane are the Froghopper (*Tomaspis postica*), the Giant Moth Borer (*Castnia licus*) and the Small Moth Borer (*Diatraea saccharalis* and another undetermined species). A report on the work done in connection with Froghoppers was published in the April number of the *Bulletin*. In January this year it was decided that I should devote myself entirely to the study of the Froghoppers and the sum of $3,022 was voted for carrying on experiments in connection with these insects. The Giant Moth Borer is present on almost every cane estate in the Colony, but only in one or two localities has it made its presence felt. Of the methods adopted for its extermination that of catching the adults by organized gangs of boys has up to now proved best. This has been done systematically on one estate for the last 18 months, with the result that the canes showed comparatively fewer borer holes during the last crop. It is hoped that all sugar estates will take up this work during the coming year. It is only by co-operation that a pest of this description can be kept under control and possibly exterminated. The small moth borer is almost everywhere present, but it is not as plentiful as one might be led to believe by the appearance of the so-called "dead hearts" in young cane shoots. A careful examination of several fields in different parts of the Island revealed the fact that the Giant Moth Borer was responsible for a large proportion of the "dead hearts." The cutting out and burning of all the dead hearts caused by small borers in young fields is recommended. The above mentioned are the insects which most seriously attack sugar cane in this Island; others observed during the past year were the "Striped Grass looper" (*Remigia repanda*), the gru-gru beetle (*Rynchophorus palmarum*), and the small beetle borer (*Sphenophorus piceus*). "The striped grass looper" is the caterpillar of a small brown moth, and as the name indicates lives on grass. Occasionally these caterpillars increase to such numbers as to eat down whole grass fields. But attacks are not of frequent occurrence. In 1901 large numbers of these caterpillars suddenly appeared in widely separated districts in all parts of the Island and devastated para and guinea grass fields. They have not been observed in such large numbers since, but in July last

year 40 acres of young canes on an estate in the Couva district were damaged. By weeding the fields the caterpillars were disturbed and when on the ground were devoured by the Savannah Black Bird (*Quiscalus crassirostris*) and the Tick Bird (*Crotophaga ani*). These birds followed the weeders quite fearlessly and simply gorged themselves on the caterpillars. A number of parasitical flies were bred from the caterpillars taken from the fields. These caterpillars are always to be found singly on grass in the cane traces, and when through the absence of their natural enemies they increase in number, numbers of them transfer their attentions to the canes. The grub of the Grugru Beetle is a secondary pest and only attacks fermenting cane stools after cutting. They were observed only in one instance and on a limited area. They will not attack healthy growing canes. The small Beetle Borer has much the same habit as the Grugru Beetle but it is more numerous. It breeds in diseased canes and in odd bits of cane left lying about the field. It will also attack canes damaged by rind fungus and the Giant Moth Borer. Shot Borers (*Xyleborus perforans*) attack only diseased canes, but last year they were not numerous. Of the greatest enemies of the sugar planter grass is one. It harbours many insects. A cheap and efficient method to destroy grass in traces and fields is a necessity, and experiments in this direction will be undertaken during the coming year. The extermination of the Mongoose and protection of insect eating birds should be encouraged on all estates.

Cocoa.

Cocoa fields harbour many insects; in fact, these estates are the Entomologist's best hunting ground. Fortunately most of the insects found there are not injurious and on the whole, with one or two exceptions insect life is fairly well balanced, there being a fair proportion of natural enemies always present. The most serious pest is the Cocoa beetle (*Steirastoma depressum*) which seems to affect young trees in recently opened up districts. Cocoa beetles eat the bark of trees and they gnaw it for making cavities in which to deposit their eggs. It appears that arsenate of lead will prevent them doing this. Some trees were therefore sprayed experimentally with this chemical and a proprietor in the Erin district was so well satisfied with the results that he imported a quantity of this insecticide to use on a large scale on his estates. Mr. Guppy, who was appointed to assist me, is now engaged in investigating the life history and habits of this beetle. The tender young leaves of a cocoa tree attract quite an army of caterpillars and beetles of several families, which although they do not constitute serious pests should be watched and destroyed if too numerous. The best insecticide to use against these gnawing insects is arsenate of lead. In the same manner that the leaves attract gnawing insects the flowers and young pods are injuriously affected by many sucking insects. The leaf hopper (*Horiola arquata*) is the most important of these. It is fairly common not only on cocoa but on several other plants. It has been observed on mango where it does a certain amount of damage to the young fruit and flowers, On cocoa it appears to be responsible for the withering of some of the young pods. Several species of ants protect these insects in

their young stages because they exude secretions of which the ants are very fond. *Heliothrips rubrocinctus* is another insect seldom absent from cocoa estates but which only does occasional damage. There was an outbreak of this insect in the Guaico district in November and December last. A paper on this pest is in course of preparation. There are quite a number of species of ants living on cocoa trees. Their relations to other insects and their agency in spreading fungoid diseases are matters for future study. It is undesirable and dangerous that any insects should be introduced on cocoa estates, it would therefore be a wise policy if every estate had a small fumigating house or box, through which all nursery stock should pass before being planted out.

COCONUTS.

At the opening of the year complaints were received that beetles were attacking and destroying coconut palms. Estates were visited in all districts of the Island with the exception of the north coast and it was found that beetles were not the origin of the trouble. Fungoid diseases were the primary cause and insects were secondary to them. In dead or dying palms still standing, larvæ of the "Bearded Weevil" (*Rhina barbirostris*) were plentiful and trees that had been recently felled attracted large numbers of the Grugru Beetle (*Rynchophorus palmarum*). At Mayaro a species of *Sphenophorus* was found attacking a tree that was affected by root disease. *Xyleborus perforans* was also found on diseased palms. In the Cedros district the adult of a Rhinocerus beetle (*Oryctes*, sp.) destroyed young coconut plants by burrowing into them from beneath and damaging the internal soft tissues. The larvæ were found in decaying coconut stems and stumps which were lying about. Caterpillars of the butterfly *Brassolis sophorae* were found in small numbers at Icacos. In 1907 these caterpillars damaged cabbage and some coconut palms in the Siparia and Naparima districts. As they have proved very destructive in Panama and British Guiana, they should be carefully observed. These caterpillars are easy to destroy owing to their habit of spinning and attaching together the pinnæ of coconut leaves, thus forming a retreat to which they retire during the day. All that is necessary is to cut off the leaf affected and burn the caterpillars. The scale insects observed were *Vinsonia stellifera*, *Aspidiotus destructor* and *Iceyra montserratensis*, but none of these occurred in any number.

MISCELLANEOUS.

At the opening of the rainy season swarms of the young nymphs of the Giant locust (*Tropidacris dux*) make their appearance in the Icacos district. Last year they appeared in May. From specimens collected adults were reared which deposited eggs in confinement. It was ascertained that the nymphal period lasted from May to July. In October the females deposited eggs, which up to now have not yet hatched. In Nature there may be slight differences in the times of maturing and laying, but it is now proved that there is but one brood of Locusts a year and with this knowledge it should be an easy matter to destroy the young nymphs when they hatch by spraying the food plants with arsenite of soda. This plan was successfully used in South Africa.

Caterpillars of a small Pyralid moth were found to be quite injurious to young Cedar plants. They damage the growing point of the plant and cause the tree to branch sooner than it should.

Collection of Economic Insects.

A metal cabinet and boxes were imported and the insect collection is progressing favourably. The identification of the specimens, owing to the want of a complete working Library, is difficult and slow and I am generally forced to rely on specialists attached to large Museums abroad. To Dr. L. O. Howard and his staff of expert Assistants I am under many obligations for the naming of specimens.

Inquiries about Insect Pests.

Inquiries have not been so numerous as I expected. Possibly the attention of Planters and others interested has not been called to the importance of sending in specimens. It is important to know the distribution and prevalence of insects, and it is principally on the Planters I rely to form a correct estimate of the distribution of insect pests in this Colony. When specimens are sent in friends and foes can be distinguished and in the case of foes investigations can be conducted at once and measures taken to suppress any dangerous species.

F. W. Urich,
Entomologist.

15th May, 1910.

At a meeting of the Board of Agriculture held in the Council Chamber, on Friday, 11th March, 1910.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (President) *in the chair*.
The DIRECTOR OF AGRICULTURE (Vice-President).
,, Hon. Mr. C. DE VERTEUIL.
,, ,, ,, G. T. FENWICK, C.M.G.
,, ,, ,, W. KAY.
,, ,, ,, R. S. A. WARNER, K.C.
Mr. J. P. BAIN.
Lieut.-Colonel J. H. COLLENS, V.D.
Mr. J. D'ABADIE.
,, W. GREIG.
,, J. MOODIE.
,, H. E. MURRAY.
,, L. SEHEULT, B.SC.
,, J. H. WADE.
THE ASSISTANT DIRECTOR OF AGRICULTURE (Hon. Sec).
,, MYCOLOGIST, Mr. J. B. RORER, M.A.
,, ENTOMOLOGIST, Mr. J. W. URICH, F.E.S.
,, ASSISTANT ENTOMOLOGIST, Mr. P. L. GUPPY.
,, CURATOR OF GARDENS, Mr. F. EVANS.

Upon taking the chair His Excellency the Governor welcomed Dr. H. A. Nicholls, of Dominica, an authority on Tropical Agriculture and formerly an honorary member of the Central Board of Agriculture, Trinidad.

The Minutes of the previous meeting of February 25th were confirmed after some alterations proposed by the Director of Agriculture had been accepted.

The detailed plan of experiments as to prevention and cure of "Froghopper" on sugar cane was presented by the Secretary and the Entomologist explained the methods of carrying it out and informed the Board that he had already begun operations. A letter from Sir Neville Lubbock to the Colonial Office 13th March, 1910, on the subject of sending out an expert Entomologist was read.—(C.S.O. 6702/08.)

The Board on the motion of the Hon. Mr. R. S. A. Warner, K.C., seconded by the Hon. Mr. C. de Verteuil approved of the experiment as detailed and passed the sum estimated for this purpose, viz., $3,022.

The Secretary briefly described to the Board the present position of knowledge as to the yields and cost of production of rubber in the Colony and the importance of obtaining definite data as to the cost of tapping and quantity and quality of rubber obtainable from Hevea braziliensis (Para) and Castilloa elastica (Castilloa). He submitted to the Board a plan for a series of experiments on rubber tapping and curing in Trinidad and Tobago informing the Board that at the following estates, plots of trees suitable for tapping would be placed at the disposal of the Board for this purpose:—

Santa Aneta ...	Longdenville	... Mr. F. Boos.
Santa José ...	Guaico	... Mr. J. G. de Gannes.
Verdant Vale ...	Arima	... Mr. J. Wade.
Poole ...	Savana Grande	... The Poole Est. Syndicate.
Richmond ...	Tobago	... Captain Short.
Louis D'or ...	"	... Mr. T. W. M. Orde.
Monte Cristo ...	Cumuto	... Mr. H. Monceaux.

On the motion of Mr. H. E. Murray seconded by Mr. J. d'Abadie, the experiments as outlined by the Secretary were approved by the Board and the sum estimated $3,000 passed for carrying them out for one year.

A letter was read from Mr. T. L. M. Orde of Louis D'or, Tobago, urging the importance of experiments to obtain reliable data as to various questions in regard to rubber cultivation, and a communication from Mr. H. R. Hamilton, Hon. Secretary of the Tobago Planters' Association asking the Board to take steps in this direction and also that they should send Mr. Carruthers to Mexico to observe the methods of tapping Castilloa as carried out in that Country.

The report of the Tobago Stock Farm Committee was submitted by the Secretary, but in the absence of the Hon. Mr. S. Henderson its adoption was postponed.

An application was read from Mr. J. Lionel Shannon, D.V.M., for the post of Manager of the Government Stock Farm on the expiration of the temporary appointment of Mr. McInroy, the Acting Manager. The Director of Agriculture expressed his approval of Mr. McInroy's conduct of the Stock Farm during the past year and on the motion of Colonel Collens seconded by the Hon. Mr. W. Kay, it was decided :—

> "That the Board recommend Government that Mr. McInroy be confirmed in his appointment as Manager of the Government Stock Farm."

A proposal by the Director of Agriculture to prevent exportation of stock bred on the Government Farm was considered and after a discussion in which the Regulation of the Government of British Guiana were read and Mr. Greig informed the Board that he had been present at a sale in Canada when cattle was sold under restrictions as to its export from the province, the matter was postponed. The Secretary was instructed to obtain information from Canada as to the methods by which the restrictions on exportation of such stock were enforced there.

A letter was read from the Secretary of the Agricultural Society of Trinidad and Tobago to the Government in regard to holding a Central Agricultural Show in Port-of-Spain in 1911, under the auspices of the Society, and asking for a grant of £600 for Prizes which had been referred to the Board. The question of the Board's contributing to the expenses of this Show was suggested and the matter referred to the Advisory Committee.

The report of the Committee on Agricultural Education was presented and the scheme explained by the Director of Agriculture. The cost was estimated at £600 per annum.

The matter was referred to the Advisory Committee. Mr. L. Seheult, B.Sc., being added to the Committee for this purpose.

Mr. H. E. Murray and the Assistant Director of Agriculture were added to the Advisory Committee.

The following recommendations of the Advisory Committee were passed by the Board :—

"That cheques be countersigned by the Hon. Mr. G. T. Fenwick, C.M.G. or Hon. Mr. R. S. A. Warner, K.C."

"That the accounts of the Board be audited every six months and Mr. Duncan Campbell be asked to do this at a fee of two guineas per audit."

The Board adjourned until Friday April 22nd, at 1.45 p.m.

J. B. CARRUTHERS,
Honorary Secretary.

CONTENTS.

Obituary Notice.

JOHN BENNETT CARRUTHERS, F.R.S.E., F.L.S.
Born 19th January, 1869.
Died 17th July, 1910.

THE following Despatch from His Lordship the Secretary of State indicates the esteem in which the services of the late Mr. Carruthers were held by the Government:—

SIR,

I have the honour to acknowledge the receipt of your Despatch No. 227 of the 18th July, reporting the circumstances of the death of Mr. J. B. Carruthers, Assistant Director of Agriculture and Government Botanist.

2. I received the intelligence of Mr. Carruthers' death with great regret, and I am sensible of the loss which the Colony has sustained through being deprived of his services.

I have the honour to be, Sir,

Your most obedient humble Servant,

(Sgd.) CREWE.

Governor
Sir G. R. LE HUNTE, K.C.M.G.,
&c., &c., &c.

Section I.—SUGAR.

Seedling Canes Returns.

THE Returns received from the Owners or Managers of the different Estates in the Colony are summarised in the following Table. Judging by the acreage returns the most popular seedlings are:—

D. 109	2,924 acres.
B. 156	2,571 ,,
D. 116	1,917 ,,
D. 625	1,117 ,,
B. 347	875 ,,

The total area under Seedling Canes is 11,540 acres.

Seedling Canes Returns, 1909 Crop.

Seedling.	Total Acreage.	Estates.
B 109 ...	78 ...	Bronte (62), Waterloo (16).
B 145 ...	20 ...	La Florrissante.
B 147 ...	140 ...	Waterloo (57), Bronte (40), Esperanza (40), Usine St. Madeleine (3).
B 156 ...	2,571 ...	Esperanza (737), Waterloo (577), Woodford Lodge (480), Brechin Castle (330), Caroni (305), Usine St. Madeleine (76), Malgretoute (28), La Florrissante (19), Orange Grove (10), Bronte (6).
B 208 ...	452 ...	Usine St. Madeleine (152), Esperanza (84), Waterloo (48), Bronte (46), Woodford Lodge (32), Orange Grove (30), Hermitage (26), Malgretoute (18), Bien Venue (10), Friendship (4).
B 306 ...	174 ...	Waterloo (117), Usine St. Madeleine (56).
B 347 ...	875 ...	Caroni (208), Waterloo (171), Brechin Castle (158), Esperanza (150), Usine St. Madeleine (73), Bien Venue (56), La Fortunée (40), Malgretoute (12), Woodford Lodge (5),
B 376 ...	80 ...	Orange Grove (38), Usine St. Madeleine (29). Esperanza (13).
B 1,529 ...	7 ...	Esperanza.
B 1,566 ...	$\frac{1}{4}$ ...	Waterloo.
B 1,753 ...	65 ...	Esperanza (60), Woodford Lodge (5).
B 3,289 ...	4 ...	Esperanza.
B 3,390 ...	$\frac{1}{4}$ ...	Waterloo.
B 3,405 ...	$\frac{1}{4}$ ...	Waterloo.
B 3,412 ...	10 ...	Orange Grove.
D 78 ...	125 ...	Usine St. Madeleine (47), Malgretoute (40), Buen Intento (28), Brechin Castle (10).
D 95 ...	79 ...	Brechin Castle.

Seedling Canes Returns, 1909 Crop.—*Contd.*

Seedling.	Total Acreage.	Estates.
D 109 ...	2,924 ...	Usine St. Madeleine (1,236), Waterloo (523), Orange Grove (460), Woodford Lodge (281), Brechin Castle (120), Esperanza (85), Caroni (78), La Fortunée (45), Bien Venue (40), Malgretoute (20), Buen Intento (19), Hermitage (7), Bronte (5), Friendship (4).
D 115 ...	37 ...	Waterloo (30), La Florrissante (4), Usine St. Madeleine (3).
D 116 ...	1,917 ...	Brechin Castle (932), Caroni (352), Waterloo (230), Esperanza (109), La Florrissante (63), Malgretoute (46), La Fortunée (35), Usine St. Madeleine (33), Bien Venue (29), Buen Intento (28), Friendship (25), Hindustan (25), Craignish (16).
D 145 ...	224 ...	Usine St. Madeleine (167), Waterloo (52), Hermitage (4).
D 146 ...	128 ...	Esperanza (70), Woodford Lodge (57).
D 156 ...	10 ...	Buen Intento.
D 207 ...	4 ...	Malgretoute.
D 625 ...	1,117 ...	Usine St. Madeleine (590), Waterloo (111), Bronte (77), Malgretoute (76), Orange Grove (70), Caroni (67), Brechin Castle (56), Friendship (28), Bien Venue (14), Buen Intento (14), Esperanza (8), Hermitage (2).
D 3,039 ...	18 ...	La Fortunée.
T 24 ...	16 ...	Esperanza.
T 33 ...	2 ...	Esperanza.
T 78 ...	6 ...	Esperanza.
T 83 ...	6 ...	Waterloo.
T 105 ...	7 ...	Waterloo.
T 108 ...	4 ...	Esperanza.
T 145 ...	5 ...	Esperanza.
T 146 ...	296 ...	Waterloo (173), Friendship (41), Bien Venue (18), Buen Intento (15), Usine St. Madeleine (14), La Fortunée (12), Brechin Castle (12), Malgretoute (10).
T 171 ...	5 ...	Waterloo.
T 247 ...	100 ...	Waterloo (80), Esperanza (20).
T 306 ...	2 ...	Esperanza.
M T00 ...	6 ...	Malgretoute.
White Tr'nsp'rent	319 ...	Waterloo (232), Usine St. Madeleine (42), Brechin Castle (34), La Florrissante (10).
Burke ...	16 ...	La Florrissante (11), Usine St. Madeleine (5).
Sealy ...	$\frac{1}{4}$ ...	Waterloo.
Bourbon* ...	3,869 ...	Usine St. Madeleine (3,200), Woodford Lodge (643), Waterloo (24).
Claret ...	93 ...	Usine St. Madeleine (56), Waterloo (36).
Exp'rim'nt Mixed	250 ...	Caroni (197), Brechin Castle (51).
Scard Cane...	$\frac{1}{2}$ ...	Usine St. Madeleine.

* Returns from 3 Estates only.

Results of analysis of Seedling Canes.

The following tables show the results of analysis of some of the Seedling Canes grown at the St. Clair Experimental Station.

These canes were reaped and analysed during the period 9th to 13th May, 1910.

Table I.—Canes planted at the end of January 1909, fifteen and a half months old at date of reaping.

Table II.—Canes planted at the end of June, ten and a half months old at date of analysis. Two of these Seedling D 64 and D 4397, although heavy canes, are exceedingly poor in Sucrose content and quotient of purity :—

TABLE I.

Canes planted January 1909. 15½ months old when analysed.

No. of Cane..	Average weight of each cane.	Per cent. juice.	Specific Gravity of juice.	Brix.	Per cent. Sucrose.	Per cent. of Glucose.	Per cent. solids non-sugar.	Quotient of purity.
D. 60 ..	2·8 lbs.	60·9	1·0587	14·4	11·22	2·32	0·86	77·9
*D. 145 ...	8·9 ,,	66·9	1·0792	19·1	17·45	0·51	1·14	91·3
*D. 366 ...	5·9 ,,	67·9	1·0770	18·6	16·69	0·41	1·50	89·7
†D. 625 ...	12·8 ,,	67·6	1·0709	17·2	13·26	2·79	1·15	77·0
*D.2468 ..	8·7 ,,	64·8	1·0828	19·9	17·25	0·67	1·98	86·6
*D.3956 ...	7·4 ,,	66·1	1·0717	17·4	14·49	1·90	1·01	83·2
*D.4397 ...	8·8 ,,	66·9	1·0744	18·0	15·78	1·27	0·95	87·6
*D.4805 ...	6·3 ,,	60·3	1·0775	18·7	16·03	0·61	2·06	85·7

* Mean of two analyses.

† Mean of three analyses

TABLE II.

Canes planted June 1909. 10½ months old when analysed.

No. of Cane.	Average weight of each cane.	Per cent. juice.	Specific Gravity of juice.	Brix.	Per cent. Sucrose.	Per cent. Glucose.	Per cent. solids non-sugar.	Quotient of purity.
T. 39 ..	2·7 lbs.	62·8	1·0873	20·9	19·16	0·96	0·78	91·6
T. 83 ...	2·8 ,,	62·5	1·0766	18·5	16·84	0·81	0·85	91·0
T. 192 ...	3·2 ,,	66·0	1·0739	17·9	15·81	1·08	1·01	88·3
T. 202 ...	2·6 ,,	67·4	1·0761	18·4	16·51	0·93	0·96	89·7
D. 64 ..	9·0 ,,	68·0	1·0468	11·6	7·27	3·51	0·82	62·6
D. 177 ...	4·1 ,,	68·6	1·0652	15·9	13·11	2·03	0·76	82·4
D. 216 ...	4·2 ,,	67·1	1·0704	17·1	13·82	2·36	0·92	80·8
D. 224 ...	3·6 ,,	66·7	1·0695	16·9	14·86	1·48	0·56	87·9
D. 294 ..	7·1 ,,	68·7	1·0630	15·4	12·45	2·32	0·63	80·8
D. 326 ...	7·0 ,,	64·2	1·0748	18·1	15·17	2·08	0·85	83·8
D. 338 ...	6·0 ,,	65·6	1·0695	16·9	14·61	1·55	0·74	86·4
D. 348 ...	5·3 ,,	70·3	1·0687	16·7	13·41	1·92	1·37	80·3
D. 358 ..	5·7 ,,	64·4	1·0647	15·8	12·23	2·50	1·07	77·4
D. 405 ...	6·0 ,,	63·2	1·0630	15·4	12·35	2·09	0·69	80·1
*D. 426 ...	4·6 ,,	63·4	1·0770	18·6	15·82	0·91	1·87	85·0
D. 433 ..	5·1 ,,	67·6	1·0735	17·8	15·53	1·62	0·65	87·2
D. 448 ...	3·7 ,,	69·3	1·0682	16·6	12·97	2·60	1·03	78·1
*D. 464 ...	5·1 ,,	66·4	1·0819	19·7	17·60	0·40	1·70	89·3
D. 504 ...	5·0 ,,	67·9	1·0770	18·6	16·15	1·62	0·83	86·8
*D. 526 ...	4·6 ,,	64·0	1·0766	18·5	15·45	1·05	2·00	83·5
D. 4395 ..	6·9 ,,	64·8	1·0609	14·9	11·74	1·91	1·25	78·7
*D. 4397 ...	6·3 ,,	63·4	1·0510	12·6	8·44	2·06	2·10	66·9
D. 4407 ...	4·0 ,,	64·7	1·0806	19·4	17·40	1·18	0·82	89·6
*Queensland.	5·6 ,,	66·4	1·0891	21·3	19·42	0·74	1·14	91·1

* Mean of two analyses.

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

18th May, 1910.

Distribution of Seedling Canes, August, 1910.

Applications for Seedling Canes available for distribution.

	Perseverance Estate, Chaguanas.	Woodford Lodge.	Brechin Castle.	Caroni.	Tennants.	Waterloo.	Bronte.	Col. Company 7 estates.	No. available.
74 ...	1,000	...	...	...	...	...	1,000	...	2,560
145 ...	750	750	...	...	...	...	...	...	1,750
294 ...	...	...	...	...	...	12	12	...	36
326 ...	...	...	12	12	...	12	...	...	48
338 ...	...	...	7	7	...	7	7	...	36
366 ...	150	120	120	...	...	...	...	...	500
464 ...	4	4	4	4	4	4	4	...	36
504 ...	...	...	...	...	20	...	...	...	36
2,468 ...	40	40	...	...	40	...	...	250	440
3,956 ...	...	...	...	100	...	...	...	200	330
4,395 ...	...	...	20	...	...	...	...	...	36
4,397 ...	...	30	...	...	30	...	...	150	225
4,399 ...	...	...	20	20	...	...	...	...	60
4,407 ...	...	...	...	12	...	...	...	...	24
4,805 ...	...	200	...	...	...	...	...	400	660
Queensland ...	15	20	20	20	20	20	20	20	175

Notes on the Biology of the Froghopper.

By Dr. Lewis H. Gough.

(*A paper read before the Agricultural Society on Tuesday, Sept. 20.*)

The following notes make no claim to completeness, owing to the shortness of the time during which I have been able to study the biology of the froghopper. Yet I believe I have established some facts which are worth making known as a preliminary communication.

THE EGGS.

There has hitherto been some doubt concerning the place where the eggs are laid, and the opinions on this matter have been very contradictory. It has been asserted that they are laid in the earth, or on the roots, or on the leaves of the canes.

I have been successful in obtaining eggs both in my experimental cages and also in the field. As far as my experience goes at present they are not deposited in the ground, but in slips made in the tissue of the leaf sheaths (or of the leaves near their bases) of the leaves nearest to the ground.

I first discovered froghopper eggs on some stems of a knot grass in a pot used in an experiment (11/9/1910). The eggs had heen laid in slits made in the bottom leaf sheaths, and were lying between the leaf sheaths and the stalk. A few were also imbedded in the tissue

of the basal portion of the leaf. (See photograph). As there was no room for the female to have crawled down inside the leafsheath, it is evident that the eggs had been introduced from outside through slits in the tissue. Some of the eggs actually protruded slightly out of their slits.

Subsequently I have found eggs in the leafsheath of a cane growing in a field at "Brechin Castle" (15/9/1910). In this case the egg was fixed in a slit in the inner surface of a withered leaf-sheath.

As yet I have only found eggs near the ground on the bottom leaves.

The eggs are yellow, measuring about 3-100th of an inch by 1-100th (·75 mm. x ·255 mm.). Their shell is very finely chagrined, rounded at one end and somewhat truncated at the other, the punctuations of the surface at this end being somewhat larger than elsewhere.

The period required for hatching has not yet been ascertained, as I have not yet had the eggs long enough for them to hatch.

The period required from the stocking of a breeding-cage with adult froghoppers to the first appearance of froth has been found at 25 days (11. 8. to 5/9/1910.) This does not however prove much, as it was not known when the first eggs were laid, neither is it proved that the nymphs produce froth immediately after hatching.

THE NYMPHS.

I have as yet only few observations worthy of record concerning the nymphs; not knowing what stage they were at when obtained it was not worth the time it would have required if any attempt had been made to count the number of moults.

Although the larvæ usually live on the roots near the surface or deep under the cane stool, it has been found possible to rear them to maturity on the stems and leaves of grasses. I have also found them in similar positions in the field.

THE ADULTS.

The adults emerge without having undergone any period of quiescence. The "froth" in which they are enclosed has been found to be quite stiff and dry when they emerge, being then no longer wet or sticky.

In the field the sexes are present in approximately equal numbers, as has been proved by counting specimens caught by hand, and checked by counting specimens emerging in the breeding cages. Of 4,451 froghoppers caught by hand, 2,148 were males, 2,303 were females.

During the day the froghoppers are usually found sitting in the angles of the leaves. They almost invariably sit with their heads uppermost. In the evening they crawl up the leaves and can then be readily seen sitting on the blades, or flying.

Copulation takes place during the day and in the evening. Copulating couples often sit side by side with their heads pointing in the same direction, upwards. Occasionally they are seen with their heads pointing in opposite directions.

Both sexes are readily attracted by light, as proved by experiment. Their attraction to light has been used as a means of exterminating them by the use of traplights. But the females are apparently more sedentary than the males, and do not get caught by traplights to the same extent. Of 12,993 froghoppers caught by traplights between August 10 and August 25 in all parts of the sugar growing area only 188 were females. These figures are substantiated by later catches; of 3,844 caught between September 13 and 15, only 44 were females. The totals for August and September together are 16,837 froghoppers of which only 232 were females.

NATURAL ENEMIES.

Of the natural enemies the most important is a species of mould which attacks adults and nymphs, killing them in from three to eight days after infection. Nymphs which are infected just before moulting for the last time, can moult and then as adults die from the infection. Death usually takes place on the fourth day after infection.

The mould is present in quite large quantities in places. At Tarouba 63 moulded froghoppers were collected and sent me. A traplight sample from the same place, containing 794 specimens, contained 10 attacked by the mould. (The sample was examined two days after taking.)

This mould grows readily and produces spores in vast quantity on bouillon-agar, bouillon-gelatine, potato-cylinders and mist-agar; it grows very slowly and has not produced spores after three weeks growth on cane-juice agar and on cane-cylinders.

PRACTICAL RESULTS.

The practical application of the data set forth above remains to be worked out.

Knowing now where the eggs are to be found, application of some insecticide (*e.g.* tobacco juice) as a spray should be of great use. The proper time for the application would be soon after the first flight of adult froghoppers is observed early in the season.

The fungus should also prove to be an excellent help in keeping down the blight, and I am inclined to think that the possibility of cultivating it on mist-agar (dung-infusion agar) may prove to be of economic importance. As to the time to spread it artificially, I am of the opinion that the right season will be the same as that for spraying the eggs. This would probably give the fungus a start of three or four months as compared to its normal occurrence. As there is absolutely no difficulty about its culture on a small scale, it should be a simple matter to grow it in the necessary quantities. —*The Mirror*, September 23, 1910.

Interim Report on Froghoppers,

BY

F. W. URICH.

THIS Report consists of some of the principal data obtained in connection with the study of the biology of the Froghopper during the past seven months, and it will be one of a series discussing not only Froghoppers and their relation to Cane Blight but also other insects affecting sugar cane.

The results obtained up to now in connection with some experiments carried on at Chaguanas are also given. These experiments were started in February and will be carried on until the canes are reaped.

INTRODUCTION.

As mentioned in my Paper "Froghoppers in Sugar Cane" (18)* "Blight" in sugar cane is of long standing and there is reason to believe that Froghoppers have always been associated with it. At the time I wrote (January 1910) I was under the impression that it was only in Trinidad that this member of the family of *Cercopidæ* did damage; but it appears that in 1883 it caused trouble in British Honduras. In his work "The Colony of British Honduras, its Resources and Prospects" Sir Daniel Morris (3) says: "A fly, or "rather moth appeared to be troublesome to canes at certain seasons "of the year. The different stages of the fly are described by Mr. Morrison as follows:—"About the end of June or July a white froth "similar to what is known in England as "cuckoo spittle" or "goat spittle" appears at the canes, both under and above ground. "On examination, a small green wingless insect is found embedded "in the froth, which remains in this state till about August, when "it matures into a fly. While affected in the manner above stated, "the canes become stunted in growth, but even afterwards with "the mature insect they are not free from injury, as the fly "attacks the leaves and causes them to be spotted and eventually die "off. The lower leaves appear to wither first, but the upper leaves "are soon attacked, and sometimes so severely as to cause the whole "to fall off, leaving nothing but the bare cane standing. Even among "canes not severely attacked the joints are short and poor. About "the end of September and October the "fly" disappears. The "canes after a time, relieved from the attacks of the fly, make very "fair growth, their joints become long and full, and they continue to "develop until cutting time."

To this account Mr. Morrison adds: "The fly is more severe in "damp and wet lands, in lower portions of fields, than in dry, "powdery land. I obtained a fly for determination and find it is "not at all uncommon in moist districts in other parts of the world.

*The numbers refer to the Bibliography which will be found at the end of this paper.

"I recommend a dressing of powdered lime to the cane stools where "the 'froth' first appears and this together with good drainage will "I believe effectually deal with the evil."—(D. Morris. pp. 35–36, British Honduras—published in Trinidad *Mirror* by Mr. J. H. Hart, F.L.S.) These observations which have been fully confirmed here are the first authentic records of the harm Froghoppers can do to canes; they are amply borne out by the experience of the Trinidad Planters. Quite recently Mr. Quelch has reported the existence of "Cuckoo spit" on Plantation Melville, in Demerara, and from specimens of nymphs that he was good enough to send me they seem to belong to the same species as the Trinidad insects. In his letter Mr. Quelch makes no mention of damage to canes, but he has the insects under observation and will no doubt issue a report in due course.

Distribution.

Mr. McLeod (12) mentions that Froghoppers may have been introduced into this Island, but there is no doubt that *Tomaspis postica* is indigenous to Trinidad. It is an insect that has a wide range of distribution in Central and Northern South America, it has been recorded by Fowler from Mexico, Nicaragua, Costa Rica and by Quelch from Demerara. It is likely that the species recorded from British Honduras by Morris was also a *Tomaspis*.

Food Plants.

The original food plant of *Tomaspis postica* is Savannah grass, but it is sometimes found on Para and Razor grass. As Savannah grass is very plentiful on some Cane estates especially those situated on low lying lands, it is quite easy for the insects to pass over to canes. It is well known that when wild plants have insect enemies and a plant related to them is cultivated among or near them, the insects generally attack the new plant, especially when their natural food plant is eradicated by the new crop, as is done to grass by high canes. From Savannah grass collected from St. Ann's, Guapo, Moruga, Cedros, Heights of Oropuche, Arima, Tunapuna, Cumuto, Montserrat, nymphs of Froghoppers were bred. I have reared adults from the egg stage to the mature insect on grass and canes. In both cases the plants suffered from the activity of the nymphs and were sometimes killed.

Life History Studies.

Egg Stage.—Eggs are deposited singly in dry cane and grass sheaths near the ground. Often they are found sticking on to a grass stem, just below the surface of the ground. The hatching of the young nymphs depends on the weather and degree of moisture in the soil. Eggs kept fairly dry remained dormant from February to June, when they hatched on being exposed to rain. On grass taken from Guapo on 25th May, nymphs hatched 9 days after. From a cane root isolated on 21st July nymphs hatched as follows: —on 23rd. 1; 28th, 2; 30th, 1; August 1st, 1; 6th, 1; 7th, 4. On another occasion during a spell of dry weather grass roots with earth adhering were taken from a field and

placed in a damp chamber, 2 days after nymphs hatched and during a week none were observed to have hatched on the grass left in the field. As a check some more of the same grass was placed in a damp chamber and 3 days after yielded nymphs. From 15th to 23rd July adult Froghoppers were introduced into an isolation cage in the open over a cane plant. Nymphs were observed for the first time on 3rd of August or 12 days after, the weather at the time was rainy. On 9th June a single pair of adults was isolated. Young nymphs were observed on 30th June. From above it would appear that the egg stage depends on weather and moisture and that under favourable circumstances it lasts from 12 to 20 days.

Nymphal Stage.—The nymphs when recently hatched attach themselves to the nearest cane or grass rootlet, but should they be disturbed, they are quite active and crawl away, their gait resembling that of an Aphid or young scale insect. During the nymphal period they remain in one place or change according to the quantity or quality of the food supply. In an isolation cage a nymph remained in the same place on a grass root for 14 days, then it changed on to a cane root twice in 2 days, after that it remained on the cane root in the same place for 17 days at the end of which period it emerged as an adult. On another occasion a nymph remained in the same spot for 35 days, its whole nymphal period.

After hatching the young nymph passes through 4 stages before issuing as a perfect insect. The period of stage I varies from 12 to 15 days, II 6 to 10 days, III 5 to 8 days, and IV 9 to 10 days making a total nymphal period or spittle stage of 32 to 42 days. In stages III and IV wing pads are visible, being larger in stage IV. When the nymph is about to change its skin for the last time the colours of the wings of the adult are visible through the skin covering the wing pads. The shed skins remain in the spittle mass after the nymph has moulted.

Adults.—The habits of the adults are described in my paper (18) and I have little to add to them now.

Multiplication.—With a view of determining the multiplication of the Froghopper and forming an idea of the time a single generation would extend over, a pair taken in copula was isolated and the following data were obtained:—On 9th June the pair was placed in an isolation cage with growing cane, roots exposed above the earth; on 12th June, the male was found dead; the female fed well on cane leaves until the 30th June when she died. At times she was seen on the cane roots where she remained for a whole day at a time, at other times she was engaged in feeding on the leaves when she remained on one spot as much as 5 to 6 hours. Unfortunately the act of oviposition was not observed, it no doubt took place at night. On the 30th June the first nymphs hatched and from this date a few more appeared every day, but owing to their position they were difficult to count, but as far as I could make out there were about 30 in all. Some died before attaining maturity and from this brood I obtained, 21 adults, 11 males and 10 females. They issued between the 1st and

30th August by ones, twos or threes. A generation thus extends in favourable weather over a period of 3 months. The adults generally issue in the morning and in the evening they are ready to mate. Those issuing early are thus able to propagate their kind before the whole brood is fully developed and one can easily understand how, in this manner there is continuous generation and a continual succession of broods, only interrupted in some localities by very dry conditions of the soil. During the dry season in favourable damp places overgrown with grass such as traces oviposition never stops and in such places eggs are always hatching. A continuous supply of food is assured by grass and canes being found in all stages of growth on estates. The proportion of males and females in the field varies according to season, but on an average 51 per cent. of the total number are males.

NATURAL ENEMIES.

Nothing new can be added to what I said under this heading in my last paper (18), but some experiments carried out in conjunction with Mr. Rorer with the fungus referred to in my paper (5) have proved that it is parasitical not only on adults but also on nymphs as well. Mr. Rorer gives an account of the fungus. For the next few months we are planning some experiments in the fields on a large scale.

METHODS OF CONTROL.

More than ever do I urge the necessity for clean weeding while the canes are young and before they keep down the grass themselves. In the act of weeding eggs and nymphs are scraped up and are accumulated in boucans and for this reason these latter should not be left on the fields when possible. They should be disposed of by burying deeply or burning when practicable. I do not think that froghoppers can ever be controlled by trap lights, the weeding is far more important. Another method of control consists in preventing grass growing on recently ploughed land by planting leguminous cover crops. So far Bengal beans seem to give the best results, but different kinds of cow peas will also be tried.

Sugar Cane Experiments in connection with Froghoppers.

Nature of Experiments.—To determine whether by taking away all food plants by which the Froghoppers carry over from crop to crop, will eradicate or reduce this pest.

Plot A.—25 acres Plant Canes, weeded twice since April. Average number of Froghoppers caught to end of August 382.

Plot B.—25 acres Plant Canes. No special treatment. Average number of Froghoppers caught to end of August 556.

Plot E.—25 acres 1st Ratoons. Weeded twice since April. Average number of Froghoppers caught to end of August 444.

Plot F.—25 acres 1st Ratoons. No special treatment. Average number of Froghoppers caught to end of August 681.

Remarks.—In plots A and B the nymphs were found up to the end of August on the grass, so far very few canes have been attacked. In Plots E and F nymphs are found on grass and canes. The fields should have been weeded oftener, but this was not possible on account of the want of labour. All traces surrounding the fields are kept clean by brushing and spraying with arsenite of Soda.

The three ratoon fields which comprise Plot E were treated as follows :—No. 1 Trash burnt off after canes were cut. Number of Froghoppers caught in 3 days at the end of July 677 ; No. 2 Trash forked in and buried. Number of Froghoppers caught at the same time as in No. 1 1,482 ; No. 3 Trash removed from field. Number of Froghoppers caught at the same time as Nos. 1 and 2 1,800.

As far as the appearance of the canes is concerned the plant canes are all healthy and growing well. The ratoons look well with the exception of those on No. 2 field of Plot E which show signs of "Blight."

During the coming months the plant canes will be dusted with spores of the parasitical fungus, in order to start an epidemic among the Froghoppers.

Bibliography of Cane Blight and Froghoppers.

1. 1863—Dr. Herman Cruger.—Cane disease and pests—M.S. discovered among papers at the Royal Botanic Gardens and published in the *Agricultural Record*, (Trinidad), October, 1892, p. 78.

2. 1879—Ernest E. A. Francis, F.C.S., F.I.C.—On a Chemical Examination of Blighted Sugar Cane, and of the Soil in which they were grown—Proceedings of the Scientific Association of Trinidad. Republished in the *Agricultural Record* of Trinidad, October, 1892, p. 96.

3. 1883—Sir D. Morris.—The Colony of British Honduras, its Resources and Prospects —The Author refers to Froghoppers and their attacks on the Sugar Cane.

4. 1889—J. H. Hart, F.L.S.—Report on Sugar Cane Blight—*Agricultural Record* of Trinidad, Vol. II., p. 126. Republished in *Bulletin* of Miscellaneous Information R.B.G., Trinidad, October, 1906, p. 152.

5. 1906—F. W. Urich.—Froghoppers—*Mirror* of Trinidad of September 19th, 1906.

6. ,, A new Sugar Cane Pest—*Agricultural News*, No. 117, 1906.

7. ,, A. E. Collens.—Report on diseased Canes at *Harmony Hall* and *Tarouba* estates. Republished in Proceedings Agricultural Society of Trinidad and Tobago, Vol. IX, pp. 117-121.

8. ,, A. E. Collens.—Result of an inspection of Cane Blight disease at *Brechin Castle* estate.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, pp. 121-124.

9. 1907—O. W. Barrett.—Blight in Sugar Cane.—Proceedings, Agricultural Society of Trinidad, Vol. VII, pp. 251-252.

10. ,, O. W. Barrett.—Notes upon Miscellaneous Crops (Sugar Cane). Proceedings Agricultural Society of Trinidad, Vol. VII, p. 300.

11. 1908—T. H. P. Heriot.—Contributions towards the study of the Froghopper, with 4 figures.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. VIII, p. 549.

12. ,, J. J. McLeod.—Paper on the Froghopper.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. VIII, p. 552.

Bibliography of Cane Blight and Froghoppers.—*Continued.*

13. „ THE FOLLOWING LETTERS AND PAPERS ON SUGAR CANE BLIGHT AND FROGHOPPER—In Proceedings, Agricultural Society of Trinidad and Tobago.

Hon. G. T. Fenwick, C.M.G.	—Vol. VIII,	page 557.
H. Caracciolo, F.E.S., C.M.Z.S.	„	„ 558.
A. E. Collens, F.C.S.	„	„ 561.
Jas. Black	„	„ 565.
J. W. Arbuckle	„	„ 566.
Jas. Gaul	„	„ 568.
Jas. Gilbert	„	„ 570.

14. 1909—J. H. Hart.—Remarks on Sugar Cane Blight.—Proceedings, Agricultural Society of Trinidad, Vol. IX, pp. 32–40.

15. „ Prof. P. Carmody, F.I.C., F.C.S.—Sugar Cane Blight and Analyses of Soils.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 107.

16. „ A. Urich, Ph. D., F.I.C.—Analysis of a heavy clay soil at Frederick (*Caroni* estate) badly attacked by Blight in July, 1908.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 114.

17. „ F. W. Urich.—Froghoppers.—Proceedings, Agricultural Society of Trinidad and Tobago, Vol. IX, p. 125.

18. 1910—F. W. Urich.—Froghoppers in Sugar Cane.—*Bulletin* Department of Agriculture, Trinidad, Vol. IX, pp. 15–21.

The Froghopper Fungus.

BY

JAMES BIRCH RORER.

IN a short article dealing with sugar cane blight and froghoppers published in 1906, F. W. Urich [5] * called attention to the fact that large numbers of the insects in the field were being killed off by a fungus, and that the brunt of the attack of blight had apparently been checked in this way. Collens, [7] and [8], Barrett [9] and [10], Hart [14], Carmody [15], and Urich in more recent papers on cane blight all attribute the death of large numbers of adult froghoppers to the fungus in question, while Collens in addition found that nymphs could be killed by inoculation with spores taken from dead adult insects.

Though all these writers were evidently dealing with the same fungus some confusion exists as to its identity. Hart and Collens first stated that it belonged to a genus of the Entomophtho, a family containing many well known insect fungi; but material sent by Collens † to the U.S. Department of Agriculture was determined as *Oospora destructor* and *Penicillium anisotliæ*; while specimens which were sent to Kew in 1908 were examined by Massee ‡ who diagnosed

* The numbers refer to the Bibliography given at the end of Mr. Urich's paper.

† Bulletin Agricultural Information, Department of Agriculture, Trinidad, Vol. IX, No. 61, p. 45.

‡ Royal Botanic Gardens, Kew. Bulletin Miscellaneous Information, No. 1, 1910.

the fungus as a new species to which he gave the name *Septocylindrium suspectum*. An examination of the fungus however shows that it is not one of the Entomophthoraceæ, nor does it agree at all with Massee's diagnosis and description. It is possible that the material sent to Kew was not well packed and became overgrown with a Septocylindrium which obscured the original fungus.

The writer so far has been able to find only one spore form of the fungus, and this is of the Oospora type, but attempts are being made to determine whether or not another type of spore is ever formed.

A detailed description of the fungus with illustrations is in course of preparation and will be published later.

The spores of the fungus are cylindrical in shape and very small, being only ·00012 inch long by ·00004 inch wide. They germinate within a few hours in water, or on any moist surface, with one or at times two germ tubes which quickly grow into long slender fungal filaments. If the spores are placed in the spittle of froghopper nymphs or on the surface of adult insects kept more or less damp the germ tubes quickly gain entrance to the interior of the insect body either through the natural openings of the body or through the thin tissue between the segments. Once within the insect the fungus threads grow rapidly and soon fill the body cavity and thus kill the host.

The dead insects do not fall to the ground but remain attached to the cane or grass leaves. Dense masses of white fungal threads quickly grow out between the segments of the dead insects and form masses of spores at the tips. The spores are cut off very rapidly in long chains. The spores in mass are olive green in colour. The number of spores formed on one insect is almost inconceivably large.

Pure cultures of the fungus were obtained by the poured plate method. The fungus grows well on a variety of ordinary culture media such as sweet and white potato cylinders, potato agar, etc.

To determine definitely that this fungus is a parasite experiments have been tried both in the laboratory and in the field.

About 30 adult insects collected by hand from cane plants were placed in a small cage over thick grass and inoculated with spores taken from a pure culture and suspended in water. Within a week all the insects were dead and those which the ants had not carried away were well covered with the green spore masses. Other insects were put within the same cage and soon died becoming covered with the same fungus. A healthy section of cane with numerous roots bearing 13 froghopper nymphs was inoculated by dusting with spores from a pure culture. The nymphs began to die two days after inoculated and within five days all were dead. Nymphs on similar sections of canes kept under exactly the same conditions remained alive and active. These experiments have been repeated several times so that there can be no doubt that the fungus in question is an active parasite, capable of killing both adult and nymph froghoppers in from 2 to 10 days according to the weather conditions.

Spores of the fungus from a pure culture were scattered broadcast over one hundred cane stools which were badly infested with adult froghoppers. An examination of the plants was made five days later and numbers of dead froghoppers were found covered with the fungus. On plants in other parts of the same field dead froghoppers were found, but they were not nearly so numerous as in the inoculated area.

Although it has been known for a long time that insects are the natural hosts for a large number of different fungi, attempts to use these fungi as a means of controlling insect pests have only been made within recent years. The most favourable results from these trials have been obtained in the Southern United States where certain scale insects and white flies are combatted by the use of entomogenous fungi.

The possibilities of using the froghopper fungus as a means of controlling this insect in sugar cane seem to be quite good, judging at least from the few trials which have already been made. The fungus is an active parasite, grows well in pure culture and can be cultivated cheaply and easily on a large scale, and produces spores in numerous quantities. Finally the most essential point in favour of its use is the fact that the froghoppers are most active in the rainy season, the time most favourable for the growth of the fungus.

The fungus is being cultivated on as large a scale as our present outfit of apparatus will allow and as soon as spores in sufficient quantities are obtained some field operations on a large scale will be started and carried on throughout the year at Chaguanas in co-operation with Mr. Urich, and will be reported upon from time to time as results are obtained.

[Extract.]—Importation of Dessicated Sugar Cane into the United States.

During the present grinding season extensive experiments have been made in Cuba on the dessication of shredded sugar cane which is pressed into bales and shipped to the United States. On arrival at its place of destination the finely divided cane chips are exhausted in a diffusion battery, the extracted juice is worked up into sugar, while the exhausted bagasse serves as raw material for paper manufacture. Sugar cane and similar products of the soil may be imported from Cuba into the States free of duty. Since, moreover, no excise duty on the manufacture of sugar is levied in that country, all the sugar extracted from such dessicated sugar cane within the territory of the United States enjoys the full protection of the Customs duty on sugar to the value of 1·685 c. per lb. on sugar from full duty paying countries and of 1·35 c. per lb. of Cuban sugar of 96 polarization.

Authorities in the United States predict that the supply of wood from the forests will become insufficient to provide all the pulp necessary for the ever-increasing growth of the paper-making

industries. Therefore every experiment having as its object the substitution of another raw material for paper is heartily encouraged Successful trials have already been made with maize cobs which formerly were burnt as a troublesome waste material and now are in consideration as a paper stuff. Further it appears that an excellent paper can be made from cane sugar bagasse, provided that this branch of manufacture is conducted on a large commercial scale and not as an adjunct to a cane sugar factory. The object of the importation of the dried shredded cane is to combine (1 the extraction of the sugar in the States from the cane imported without paying import duty; and (2) the manufacture of paper from the resulting bagasse in a paper factory specially designed for the purpose.

The experiments are being carried out at Central Preston, situated at Nipe Bay in the Oriente province of Cuba. Daily 300 to 400 tons of cane are reduced to very fine chips in a *Warmoth Shredder*, and the shredded cane is dropped in a drying apparatus consisting of several miles of iron steam tubes running to and fro in an iron tank. This same tank contains several rows of inclined iron plates, which are kept in a constant shaking motion. The cane chips fall on the plates, are shaken down, drop in a lower row and so on, until they reach the bottom in a dessicated state Now the pith is separated from the rind and both are compressed separately into bales in a hydraulic press. The first trials have given rather satisfactory results, and have shewn that very little sugar is lost during the operations, and that on extraction in a diffusion battery juice could be obtained of about the same purity as that capable of being extracted from the fresh canes by a set of mills.

We have no data relating to the cost of drying the cane shreds in Cuba; such figures vary considerably according to the country. So far as at present we can see this must be the principal difficulty, for all other points seem to be of minor importance.

A general application of this process is, however, impossible as its chief advantage is the difference between the customs duty of raw sugar imported in the United States in the form of sugar and of that still incorporated in the shredded and dried cane. A second advantage is furnished by the fact that the United States do not levy an excise duty on sugar produced within their territory, so that the sugar from the cane imported from Cuba is exempt from every duty. The importation of such prepared cane will, therefore, only be advantageous for countries having a similar customs system as the United States and even then only between countries which are not very far distant, so that the cost of Transport will not consume all the profit.

Cuba and perhaps some other West Indian Islands may come within this category; but in our opinion it is an exaggeration to pretend that the scheme proposed above will be able to overturn the cane sugar industry not only of Cuba, but of all other cane growing countries.—(*The International Sugar Journal.*)

Cane Dessication.

At the Preston Factory. Nipe Bay, Cuba, some experiments on cane dessication are now being carried out. the object in view being to export the dessicated material to the United States, where the juice will be extracted by diffusion and the bagasse utilized for the manufacture of paper pulp. Such a method of working it is asserted. will revolutionize the sugar industry of Cuba and probably that of all sugar cane growing countries. It is claimed that the profit from working the exhausted bagasse into paper pulp will alone cover the costs of transport and dessication; and further that considerable economy of installation and amortization will be effected, since under the new scheme one factory would have the capacity of three under the existing system. (*The International Sugar Journal*).

Section II.—CACAO.

Steirastoma depressum L.

"Cocoa-borer beetle."

By J. L. Guppy, Assistant Entomologist.

Read at a meeting of the Board of Agriculture.

Introduction.

For many years past this beetle has been a serious pest, and a source of annoyance to planters in several parts of this Island.

Nothing definite seems to have been worked out in regard to its life-history and its habits appear to have been only superficially observed,—a series of short and incomplete references to it have been brought out from time to time in various publications.

The most persistent and careful observations are required when dealing with the life-history of this class of insect possessing such a lengthy and elaborate life cycle,—much time and patient investigation being necessary before any results can be obtained.

It is hoped that the notes and recommendations now offered may be of assistance to planters.

Distribution.

This beetle is found in Venezuela, Colombia, Surinam, British Guiana, Grenada, and Guadeloupe. The Longicorn family to which it belongs inhabit the thickly wooded districts of South America, but it appears that among the numerous and varied genera that are destructive to vegetation, the genus Steirastoma is the only one that has so far developed a species that can be reckoned as a serious pest to cocoa. Their distribution would be pretty easy seeing that infested trees can be waterborne during floods.

FOOD PLANTS.

Besides cocoa, the beetles are attracted to "Chataigne maron." (wild chataigne) and the freshly cut bark of the silk cotton tree, the first two are eaten in much the same way, by biting at the outside bark with their powerful jaws,—the silk-cotton bark is eaten from the side cut away from the tree.

LIFE-HISTORY.

(*a.*) *The egg* is elongate-ovate, shiny, pale-yellow, slightly thicker at one end, and semi-translucent. It is inserted in the bark tissues through a longitudinal incision made by the strong sharp mandibles, or jaws of the beetle, and by means of the ovipositor pushed someway into the bark. Much care and deliberation is taken in the process, and quite a long time is taken before the act of oviposition is completed. Only a single egg is laid in a day, perhaps two, and days may elapse without the act being performed. A single female lays from 20 to 40 eggs as far as can be judged from specimens kept in captivity, -dissected specimens caught in the field contained 9—19,—20 to 40 eggs.

The act of copulation is frequently performed between the acts of oviposition.

The examination, with the aid of a pocket lens, of young trees at the "fork" or "jorquet," in beetle infected areas, will often reveal the presence of longitudinal slits an inch or two above, or below the forks, and at the "collar" of the trees which indicate, in most cases, the presence of eggs, or small worms within the bark.

I say in *most* cases these small slits indicate the presence of eggs, or worms, as the beetle often makes pits which are prepared for, but are not always used, for laying in, as she is very cautious.

It is very difficult to detect egg-pits in old trees as the bark is rough and gnarled.

(*b.*) *Larva* (or Worm).—The young worm escapes from the egg through a longitudinal slit which it makes with its jaws, and starts by eating away a suitable and roomy tunnel in the soft succulent bark. At first there is very little, if any external evidence of its presence and considerable damage has been already done before there is any excreta, or gummy exudation below the "fork" or "jorquet" to show its activity. The colour of the worms is pale yellow, with a small dark head, the dark colour noticeable on some worms is produced by old or diseased wood having been consumed.

The worms as a rule tunnel spirally starting from the "crutch" of the fork and going downwards, (described as "ringing the

jorquet"),—until they are pretty nearly full-grown when they enter the heart of the tree, or branch to pupate, ("turn to a chrysalis"). In old trees with considerable girths, their operations vary.

Certain "favourite" trees are riddled in every direction, and the worms merely tunnel where there is sound bark left.

(*c.*) *Pupa* (=*chrysalis stage in butterflies*). -The pupal stage is passed in the heart of the tree, or branch, where the worm has tunnelled to complete its growth,—the form it assumes is much the same as that of the future beetle, it is however the same colour as the worm.—

(*d.*) *Imago or perfect insect.*—The bettle pushes its way out of the tunnel through one of the holes that is made by the worm,—as an exit has to be provided,—the tunnel being usually too narrow to admit of turning round.

The difference in the sexes may be told by the antennæ,—those of the male, being longer. The size of the beetles has nothing to do with sex,—some very diminutive specimens are met with, only $\frac{1}{2}$ in. long, the usual length being $\frac{7}{8}$ of an inch.

The beetles do not readily take to flight but when disturbed drop to the ground and simulate death.

The various stages in its life cycle are as follows :—

Period of incubation of egg	5 days.
Length of time in which the worm tunnels (shortest period)	60 ,,
Pupa or chrysalis stage	12 ,,
	77 days.

or a little over $2\frac{1}{2}$ months.

This period is often extended to 3 or 4 months. There are many causes for retarded development through unsuitable food, or short supply, and probably other causes.

The beetles in the perfect stage (winged) live about 3 months. The average of 50 specimens in captivity might work out less, but I think it would be more, under favourable circumstances such as they enjoy in cocoa plantations.

Seasonal History.

They are particularly active during a dry spell when preceded by heavy weather and are more numerous in the dry season, frequenting

sunny spots, and the females feed and lay between the hours of 10 a.m. and 2 p.m. In exposed, sunny areas, where the cocoa trees do not flourish, seem to be the best places to look for beetles.

Too much moisture affects the worms injuriously water getting into their tunnels seems to produce some sort of disease which causes them to rot, this would account for their being not so numerous in the wet season.

EFFECTS OF SHADE AND SUNLIGHT.

A few remarks under the above head will I hope remove any misapprehension which may arise as regards the effect of dispensing with, or thinning out shade.

The removal, or thinning out of shade, would not necessarily mean an increase in the damage done by beetles on a cocoa estate liable to such attacks. The thick foliage put on by trees properly cultivated would render them unattractive and if the planter is thoroughly aware of the life-history of this pest, and the methods recommended for its control, there need be no fear of increasing its sphere of activity.

CONTROL.

(1.) Egg-pits are not easy to discover, but by training the eye to detect them, specially when the young trees show signs of being scarred by the jaws of the beetles, it would help a good deal, as eggs and small worms can be removed before serious damage is done.

It is an advantage also to know when trees are very much attacked so as to make use of them as decoys and for setting traps, and there is no better indication of this in places where the beetles are active than the numerous "scars" along the young branches, this is the case with trees from 2 to 6 years old, and such trees should be alternately sprayed with arsenate of lead and tarred at the crutch.

In badly attacked areas I would recommend spraying alternate rows of trees, and tarring at the crutch,—this will have the effect of driving the beetles from the dirty trees (= those that are tarred), to the clean trees (= those that are sprayed).

(2.) The use of Traps is recommended *in all cases.* Besides placing heaps of freshly cut chataigne branches from 1 to 1½ inches thick, similar ones 3 or 4 feet long should be stacked against the young trees, just a few of them, between the forks—especially against those trees most frequently attacked. The bark of the silk cotton tree should also be used as recommended further on.

Heap-traps of chataigne, or cocoa twigs can be left on the ground for a few weeks when they must be gathered and burnt without fail.

There is no doubt that beetles are attracted to freshly cut chataigne and cocoa wood, and eggs will mostly be found on those portions used as traps which are nearest the ground.

(3.) All dead wood must be removed and burnt, but there will be no harm done if twigs and chupons are left on the ground till the leaves drop away, as it is known that the leaves have a manurial value.

(4.) There must be a systematic search for both worms and beetles as often as possible, especially during dry sunny weather. The beetles appear to be most plentiful during dry spells preceded by wet weather. And take care to pick out your most intelligent and keen sighted men for the purpose. They are not easily seen on account of their appearance harmonising so well with the trees.

Badly attacked trees and branches had better be cut out and removed altogether. or let a suitable chupon replace an old tunnelled tree. but burn the rest. It may be worth while to save some trees with holes. instead of hacking at them to remove worms, a small quantity of carbon-bisulphide might be injected and the holes filled up.

Wherever portions of trees are removed, or worms cut out, an application of tar or some such dressing must be made, as the beetles like freshly cut wood and will attack the spot again.

In the *West Indian Bulletin*, Vol. VI, p. 94. reference is made to a method practised in Surinam for controlling this pest which consists of "tying pieces of the bark of the silk-cotton tree round "cocoa trunks to furnish hiding places for the beetles, from which "they are collected." I also recommend this as they lay eggs in the bark, which must be collected and burnt every two or three weeks.

That the beetles have a hand in the spread of canker and kindred diseases seems probable as they feed on the bark of healthy and unhealthy trees equally readily,—as well as make incisions for laying their eggs with their powerful jaws and moving from tree to tree, infection can be carried in this way.

Cocoa pods are occasionally attacked,—Hart has recorded this at St. Clair, and I have confirmed it in three instances from the same locality.

Arsenate of lead.

To spray with arsenate of lead use from 5 to 6 lbs. to 50 gallons of water.

Mix into a thin paste first before adding the full quantity of water.

The mixture *must* be agitated all the time it is in use.

It should form a light whitish wash on the branches, or wherever applied.

Use it on young branches and chupons scarred by the jaws of the beetles, it is most effective if applied during dry weather.

A detailed bulletin with illustrations is in course of preparation.

Manurial Experiment Plots—(River Estate).

Full Mulch = 200 lbs. green dressing per tree.

Mark on Plots.	No. of Trees.	Manures Applied.								
		Sheep Manure.	Bone Meal.	Sulphate of Potash.	Ammonium Sulphate.	Bird Manure.	Pen Manure.	Basic Slag.	Lime.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	loads.	lbs.	lbs.	
				Field 1.						
A	50				No	Manure.				
B	50	280	100	25	...	...	.	...	...	
C	50	280	...	13	13	...	...	..	...	
D	50	560	...	..	...	...	..	..	..	
E	50	...	...	...	..	...	24	..	...	
F	50	...	...	13	..	...	12	100	...	
G	50				No	Manure.				
H	50	...	..	..	...	187	...	...	...	
I	50	...	...	50	25	94	...	...	...	
J	50	...	...	25	13	94	...	...	...	
K	50	..	...	25	...	94	...	100	...	
L	50	..	...	...	...	...	...	...	187	
M	50	...	...	25	...	...	...	100	...	And half mulch twice.
N	50	...	...	13	13	...	..	50	...	And half mulch twice.
O	50			Two	Full	Mulches.				
P	50	..	100	13	13	..	12	...	..	
Q	50	..	...	25	13	...	12	...	...	
R	50	...	...	25	25	...	..	...	..	
S	50	...	200	25	25	...	...	...	..	
T	50	...	...	25	25	..	...	100	..	
U	50				No	Manure.				
V	50	...	...	..	...	187	...	...	...	
W	50	..	...	...	...	...	...	...	94	
				Field 6.						
1	1,018	4 tons	..	...	...	...	..	...	...	
2	500	..	...	...	...	1 ton	..	...	..	
3	520	1 ton	...	..	..	1 ton	...	...	...	
4	202				Full	Mulch.				
5	307	...	1,200	150	150	...	...	...	...	And full mulch.
6	300	...	...	300	...	..	...	1,200	...	And full mulch.
7	1,000	...	...	...	...	..	80 tons	...	..	
8	504	...	...	250	125	..	...	2,000	..	
9	500				No	Manure.				

"RIVER" ESTATE.

Field Plan of Manurial Experimental Plots—50 Trees per Plot.

	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.
	280 lbs. Sheep 100 ,, B.M. 25 ,, K_2SO_4 on 2/11/09.	280 lbs. Sheep 13 ,, Am_2SO_4 13 lbs K_2 SO on 3/11/09	560 lbs. Sheep on 3/11/09.	24 Loads Pen Manure on 22/11/09.	12 loads P.M. 100 lbs. B.S. 13 lbs K_2SO_4 on 24/11/09.	Blank.	187 lbs. Bird at $24 per ton on 4/11/09.	94 lbs. Bird at $24 per ton. 25 lbs. Am_2SO_4 50 lbs K_2SO_4 on 11/11/09.	94 lbs. Bird at $24 per ton. 13 lbs. Am_2SO_4 25 lbs K_2SO_4 on 11/11/09.	94 lbs. Bird at $20 per ton. 100 lbs. B.S. 25 lbs K_2SO_4 on 11/11/09.	187 lbs. Lime on 2/11/09.
A.	M.	N.	O.	P.	Q.	R.	S.	T.	U.	V.	W.
Blank.	100 lbs. B.S. 25 ,, K_2SO_4 ½ Mulch after on 2/11/09. ½ Mulch repeated on 10/1/10.	50 lbs. B.S. on 26/11/09. Mulch 30/11/09. Mulch 11/1/10 13 lbs K_2SO_4 13 ,, Am_2SO_4 on 7/3/10	Full Mulch 4/1/10. Full Mulch repeated 13/1/10.	12 loads P.M. 100 lbs. B.M. 13 lbs K_2SO_4 13 ,, Am_2SO_4 on 25/11/09.	12 loads P.M. 25 lbs K_2SO_4 13 ,, Am_2SO_4 on 26/11/09.	25 lbs K_2SO_4 25 ,, Am_2SO_4 on 4/11/09.	200 lbs. B.M. 25 lbs K_2SO_4 25 ,, Am_2SO_4 on 4/11/09.	100 lbs. B.S. on 26/11/09. 25 lbs K_2SO_4 25 ,, Am_2SO_4 on 7/3/10.	Blank.	187 lbs. Bird at $20 per ton on 4/11/09.	94 lbs. Lime on 2/11/09.

B.M.=Bone Meal. B.S.=Basic Slag. P.M.=Pen Manure. Full Mulch=200 lbs. per tree.

Proposed Experiments at "River" Estate.

(A and B have not been approved).

Plot.	Field.	No. of trees.	Distance now.	Treatment.	Nature of Experiment.
A	No. 1	500	12 x 12	Cut out and make trees 24 x 24 feet apart.	Distance leaving the same shade trees (Erythrina) to the acre reducing by *half the trees.*
B	No. 8	500	12 x 12	Cut out and make trees 36 x 36 feet apart.	
C	No. 8	500	12 x 12	50 per cent. poorest trees removed.	
D	No. 8	500	12 x 12	None—control.	
E	No. 3	500	15 x 15	50 per cent. shade trees removed.	Shade Experiments. Removal entirely or partially of shade trees.
F	No. 2	500	15 x 15	Control (none).	
G	No. 4	500	15 x 15	All shade trees removed.	
H	No. 5	500	15 x 15	All "Chupons" left.	Pruning Experiments in relation to upright branches from stem or "Chupons."
I	No. 8	500	15 x 15	(4 left) 2 or 3.	
J	No. 8	500	15 x 15	(1 left).	
K	No. 8	500	15 x 15	All removed when green.	
L M			Trees on all these plots to be numbered consecutively *i.e.*, from the 1st in A 1 to the last in K 5,500.		Records of No. of pods from each tree and notes as to monthly or fortnightly appearance, &c., &c.

Cocoa Experiments at "River" Estate.

REPORT OF COMMITTEE.

Two of the Committee visited the *River* Estate, on Monday last, Mr. de Verteuil was unable to accompany us, but he had already visited the Estate.

We inspected the Manurial Experiments in progress which have been started since November, and some of them even at this early stage are beginning to show the effects of the treatment.

With regard to the experiment on Shade, these have been already approved, and the only experiments now to be considered are those on the Cacao trees.

As to the proposed reduction of the number of cacao trees from 302 to 75 per acre in Experiment A, and from 302 to 33 per acre in Experiment B, we are of opinion that they should not be carried out for the following reasons :—

1. The cutting away of so many full grown healthy trees which now give at 2 lbs. per tree, about 600 lbs. of cacao per acre requires very serious consideration. The proposed experiment A would leave only 75 trees to the acre. Those trees would need to yield 8 lbs. each yearly to give the same yield as 302 trees. The proposed experiment B would leave only 33 trees per acre. These trees would need to yield 18 lbs. each.

2. It is an experiment which is not likely to be adopted on Estates as these are valued at so much per tree. Assuming the present value of each tree to be $1, the value of each tree in plot A would have to increase to $4, and in plot B, to $9.

3. In plot C, a similar experiment will be carried out to study this question of wide planting by the removal of 50 per cent. of the poorest trees. This does not require the sacrifice of the best bearing trees which would be unavoidable in Experiments A, and B. The trees in question are 25 years old.

4. If the Board desire it the same experiments could be carried out on Contracts ready to take over on which the trees are of less value ; but we consider for such an experiment it would be more prudent and judicious to make the experiment on trees planted at those distances from the start.

5. The Chupon experiments are in hand and we suggest that the same object can be obtained from 250 trees in each block instead of 500, and that in one plot all the chupons or renews should be left as originally proposed, that instead of 4 only 3 be left, and that other experiments be made with 2 and 1 renews left, and another with all the renews removed.

J. D'ABADIE,
per C. DE VERTEUIL.
J. P. BAIN.
P. CARMODY.

29th July, 1910.

Shade and Chupon experiments "River" Estate.

Plot.	Field.	No. of Trees.	Age of Trees.	Distance apart.	Treatment.
A ...	No. 5	500	25—30 years	15 x 15	Full shade.
B ..	No. 5	500	25—30 ,,	15 x 15	No shade.
C ...	No. 5	500	25—30 ,,	15 x 15	Partial shade *i.e.*, 50 % shade trees removed.
D ...	No. 8	100	7— 9 ,,	12 x 12	All chupons allowed to grow.
E ...	No. 8	100	7— 9 ,,	12 x 12	3 chupons allowed.
F ..	No. 8	100	7— 9 ,,	12 x 12	2 chupons ,,
G ...	No. 8	100	7— 9 ,,	12 x 12	1 chupon ,,
H ..	No. 8	100	7— 9 ,,	12 x 12	No chupons ,,
"D.D" ...	No. 8	100	25—30 ,,	15 x 15	All chupons allowed to grow.
"E.E" ..	No. 8	100	25—30 ,,	15 x 15	3 chupons allowed.
"F.F" ...	No. 8	100	25—30 ,,	15 x 15	2 chupons ,,
"G.G" ..	No. 8	100	25—30 ,,	15 x 15	1 chupon ,,
"H.H" ...	No. 8	100	25—30 ,,	15 x 15	No chupons ,,

Spraying Cacao trees, "La Gloria" Estate.

Number of trees sprayed		42,000
Number of gallons of Bordeaux mixture used		5,900
Cost of 5,900 gallons Bordeaux mixture	$56 46	
Cost of labour spraying 42,000 trees	48 93	
One gallon Bordeaux mixture sprayed ..		7 trees.
Average number of trees sprayed per man per day		214 trees.
Average cost of spraying 100 trees	$ 0 25	

JOSEPH DE VERTEUIL.

Cacao Polishing Machine.

One would gladly welcome an efficient polishing machine which would replace the time-honoured method of "dancing." Mr. Olivieri's octagonal revolving box goes a long way in that direction. The size on view at Messrs. Gordon Grant & Co's. Offices polishes a fanega (110 lbs.) in 4 minutes. It requires 2 men to work it. Allowing an extra two minutes for filling and emptying a machine of this size it can polish 10 fanegas per hour or 100 fanegas per day of 10 hours. It cleans the Cacao at the same time from dust, small husk, etc. It is likely to prove a serviceable machine in the drying house when the beans have arrived at the stage best suited for polishing and Mr. Olivieri is to be congratulated on its simplicity and efficiency. Several machines are being made for use on Mr. Gordon's estates. A machine driven by an oil engine would be a decided improvement.

Cacao Budding.

The first success, I believe, in budding cacao took place in Jamaica a few years ago by Mr. Harris an officer attached to the Department of Agriculture of that island, and was subsequently recorded in a printed leaflet, as an official publication, for the information of others. This news rather inspired us at the Botanic Station in Tobago to set to work and repeat the great advance in the propagation of the cacao tree, if possible. Many trials were made and as many failures was the result. Finally, as in most efforts, we met success. The person who really can claim credit on that island of being the first in the field was a student at the Station by name Henry John, shortly afterwards followed by the Foreman, Mr. James Blackman. Each only got one plant, however, to unite bud with stock. This happened during last year and, so important was it considered, at the time, that it was decided to make it a semi-public announcement, at a meeting held in Scarborough over which presided the Reverend G. Benjamin Byer, and at which were exhibited the two plants in question.

I am far from satisfied that cacao budding in Tobago has reached anything like practical grounds yet, owing to the large percentage of failures, but efforts are still in progress to try and discover where the difficulty lies. Providing success on practical grounds is eventually attained it is, I think safe to say, bound to oust the cumberous

methods one has to follow in the grafting (inarching) of the same plant.

There is no record, so far as I know, to show that cacao-budding has ever been successfully done in the bigger island of Trinidad.

Our stock plants were grown in bamboo pots.

W. E. BROADWAY.

A Self-propped Cacao Tree.

ON the St. Privat estate at Manzanilla, the property of Dr. J. F. de Gannes, an interesting example is to be seen of a leaning cacao tree supported by a root springing from the trunk, four feet from the base, and growing thence vertically to the ground, a distance of about three and a half feet, thus forming a most efficient prop.

It appears that the tree was originally propped with a dry immortel branch, some time afterwards it was noticed that a small rootlet had sprung from the point of contact, which continued to grow along the immortel prop fixing itself, as it increased in size, to the rotting prop by means of rootlets until it eventually reached the ground, when it rapidly developed in size and is now fully one inch in diameter, forming a living growing prop to the tree.

In view of the fact that the tendency of leaning cacao trees is to produce chupons along their trunks, a means would appear to be at hand whereby planters could make such trees self-supporting; by taking advantage of the well known propensity of chupons to produce roots at their base, a hollow bamboo filled with well rotted leaf-mould placed at this point of a chupon conveniently situated on the trunk, would encourage the development of these roots and form a means of communication with the ground.

It would certainly be an interesting experiment of great practical utility.

L. A. BRUNTON,
Agricultural Inspector.

The following table, showing the world's production and consumption of Cacao, is, with the exception of the figures for percentages of increase or decrease taken from the "Gordian."

Those given for Trinidad do not agree with the official returns; but this may partly be due to the fact that the official returns are for the year ending 31st March, and crop returns are frequently made up to the 31st December:—

World's Production of Cacao (in Kilos).

N.B.—Kilos multiplied by $2\frac{1}{5}$ = lbs.

Countries of Production.	1902. Actual Production.	1903. Actual Production.	1904. Actual Production.	1905. Actual Production.	1906. Actual Production.	1907. Actual Production.	1908. Actual Production.	1909. Actual Production.
Brazil ...	20,642,000	20,900,000	23,160,000	21,090,000	25,135,000	24,528,000	32,956,000	33,818,000
Ecuador ...	24,398,000	23,005,000	28,564,000	21,127,000	23,426,000	19,670,000	32,119,000	31,563,000
San Thome ..	17,969,000	22,450,000	20,526,000	25,379,000	24,477,000	24,356,000	28,728,000	30,261,000
Trinidad ...	17,612,000	13,821,000	21,878,000	22,017,000	12,983,000	18,611,000	21,737,000	23,390,000
British West Africa	2,710,000	2,580,000	5,772,000	5,620,000	9,738,000	10,451,000	14,256,000	22,473,000
Venezuela ...	9,925,000	12,550,000	13,048,000	12,700,000	12,864,000	13,471,000	16,303,000	16,847,000
Dominican Republic	8,975,000	7,825,000	13,557,000	12,604,000	14,312,000	10,151,000	19,005,000	14,817,000
Grenada ...	5,191,000	4,698,000	5,983,000	5,236,000	3,745,000	5,205,000	5,158,000	5,441,000
German Colonies ..	658,000	918,000	1,109,000	1,454,000	1,367,000	1,966,000	2,737,000	3,869,000
Ceylon ...	2,673,000	3,075,000	3,254,000	3,224,000	2,509,000	4,699,000	2,836,000	3,587,000
Jamaica ...	1,525,000	1,696,000	1,650,000	1,357,000	2,505,000	2,218,000	2,694,000	3,214,000
Fernando Po ...	1,637,000	1,734,000	2,053,000	1,911,000	1,630,000	2,624,000	3,000,000	2,725,000
Dutch East Indies..	889,000	1,469,000	1,018,000	1,030,000	1,849,000	1,800,000	2,378,000	2,470,000
Haiti ...	1,654,000	2,477,000	2,357,000	2,162,000	1,820,000	2,226,000	2,709,000	2,121,000
Cuba ...	1,875,000	2,540,000	2,697,000	1,767,000	3,271,000	1,713,000	826,000	1,939,000
Surinam ...	2,355,000	2,224,000	854,000	1,681,000	1,482,000	1,625,000	1,699,000	1,897,000
French Colonies ...	1,115,000	1,037,000	1,079,000	1,179,000	1,262,000	1,387,000	1,421,000	1,500,000
Congo State ...	?	?	231,000	194,000	402,000	548,000	612,000	769,000
St. Lucia ...	765,000	785,000	605,000	858,000	703,000	779,000	614,000	700,000
Dominica ...	?	?	493,000	589,000	572,000	548,000	487,000	600,000
Costa Rica ...	?	?	?	?	176,000	277,000	340,000	234,000
Other Countries ...	700,000	700,000	900,000	800,000	1,000,000	1,000,000	1,000,000	1,000,000
Total ...	123,272,000	126,491,000	150,794,000	143,988,000	147,240,000	149,898,000	193,622,000	205,242,000
Increase on previous year ...		2·6 per cent.	19·2 per cent.	—	2·2 per cent.	1·8 per cent.	29·1 per cent.	6·0 per cent.
Decrease on previous year ...		...	...	4·5 per cent.	—	—	—	—
Nett Increase 1909 over 1902 ...		56·4 per cent.						

World's Consumption of Cacao (in Kilos).

Countries of Consumption.	1902. Actual Consumption.	1903. Actual Consumption.	1904. Actual Consumption.	1905. Actual Consumption.	1906. Actual Consumption.	1907. Actual Consumption.	1908. Actual Consumption.	1909. Actual Consumption.
United States ...	23,120,000	27,291,000	32,164,000	35,231,000	37,948,000	37,526,000	42,615,000	53,378,000
Germany ..	20,687,000	21,634,000	27,101,000	29,633,000	35,260,000	34,515,000	34,351,000	40,724,000
England ...	20,386,000	18,681,000	20,542,000	21,190,000	20,132,000	20,159,000	21,051,000	24,264,000
France ..	19,343,000	20,741,000	21,794,000	21,747,000	23,403,000	23,180,000	20,444,000	23,254,000
Holland ...	9,172,000	10,730,000	12,184,000	10,737,000	11,224,000	12,219,000	15,821,000	19,387,000
Switzerland ..	5,707,000	5,856,000	6,839,000	5,218,000	6,466,000	7,124,000	5,820,000	6,684,000
Spain ...	6,002,000	6,026,000	5,816,000	6,101,000	5,636,000	5,628,000	6,580,000	5,979,000
Belgium ...	2,277,000	2,767,000	2,792,000	3,018,000	3,861,000	3,254,000	4,554,000	5,009,000
Austria Hungary...	1,820,000	2,034,000	2,510,000	2,668,000	3,312,000	3,471,000	3,707,000	4,245,000
Russia ...	1,818,000	1,900,000	2,055,000	2,227,000	2,670,000	2,473,000	2,588,000	2,931,000
Italy ...	466,000	468,000	479,000	971,000	1,385,000	1,455,000	1,432,000	1,615,000
Denmark ...	826,000	1,150,000	996,000	1,125,000	1,190,000	1,225,000	1,200,000	1,515,000
Canada ..	312,000	585,000	600,000	654,000	1,035,000	1,115,000	1,077,000	1,173,000
Sweden ..	591,000	774,000	870,000	896,000	1,057,000	696,000	974,000	1,135,000
Australia ..	554,000	443,000	500,000	450,000	386,000	532,000	697,000	750,000
Norway ..	410,000	439,000	472,000	493,000	580,000	524,000	466,000	735,000
Portugal ..	112,000	136,000	146,000	138,000	145,000	150,000	171,000	200,000
Finland ...	47,000	61,000	60,000	60,000	86,000	103,000	85,000	86,000
Other Countries ...	800,000	800,000	1,000,000	1,000,000	1,000,000	1,200,000	1,500,000	1,800,000
Total ...	114,455,000	122,525,000	138,821,000	143,564,000	156,783,000	156,557,000	165,138,000	194,871,000
Increase on previous year ...		7·0 per cent.	13·3 per cent.	3·4 per cent.	9·2 per cent.	—	5·4 per cent.	18·0 per cent.
Decrease on previous year		...	...	...	...	·1 per cent.	—	—
Nett Increase 1909 over 1902 ...		56·2 per cent.						

Section III.—COCONUTS.

Average price of Coconuts.

1900 ...	... As they run	...	$13 50 per 1,000—(New York.)
1901 ...	... "	...	11 50 " "
1902 ...	... "	...	14 00 " "
1903 ...	... "	...	12 00 " "
1904 ...	... "	...	12 00 " "
1905 ...	... Selects	...	15 00 " "
	Culls	...	9 25 " "
1906 ...	... Selects	...	16 00 " "
	Culls	...	9 50 " "
1907 ...	... Selects	...	17 00 " "
	Culls	...	12 00 " "
1908 ...	... Selects	...	17 25 " "
	Culls	...	12 00 " "
1909 ...	... Selects	...	19 00 " "
	Culls	...	11 00 " "
1910 ...	... Selects	...	19 25 " "
	Culls	...	11 00 " "

(Trade Statistics, Collector of Customs.)

Market Prices.

COCONUT OIL.

	October, 1910.	*October, 1909.*
Cochin per ton ...	... £51 ...	£37
Ceylon ...	... £43—44 ...	£35½

COPRA.

Cochin ...	... £50 ...	£33
Ceylon ...	... £43 ...	£32

Section IV.—OTHER FRUITS.

Banana Experiments, St. Augustine Estate.

Department of Agriculture,
24th September, 1910.

Sir,

I have the honour to forward herewith a copy of a report from the Manager, St. Augustine Estate, on Experiments in Banana cultivation extending over a period of four years.

In the first two years considerable difficulties were experienced by every one who, encouraged by the facilities afforded by the British West Indian Fruit Company, had taken up banana cultivation and some of the private growers were unable to continue the cultivation owing to the unremunerative prices obtained.

Notwithstanding the early reverses described in the report, the experiment has been continued at St. Augustine Estate, and it is satisfactory to be able to show a profit on the last year's working. Still more satisfactory are the results obtained since the close of the financial year owing to the increased prices at which the bananas were sold. The average nett price per bunch for the year 1909–10 was 21½ cents; for the five months April to August, 1910, the average nett price has been 33 cents.

By these experiments the superiority of the Governor variety under local conditions has been clearly established, and the difficulties at first experienced in shipping this variety have been overcome.

Another important fact has been established, viz.: the suitability of pen manure for the growth of bananas. All our soils are deficient in organic matter: and a dressing of pen manure at the rate of 40–50 tons per acre has produced the very satisfactory results shown in the report.

The raising of stock in conjunction with banana cultivation is therefore vary desirable if not absolutely essential; and the absence of Live Stock from the cycle of farming operations has frequently been referred to in my reports as one of the weak points in tropical Agriculture.

From the results now published it appears probable that a profit of $200 per acre may be expected from the intensive cultivation of bananas under present conditions and prices if an adequate dressing of pen manure is available at a reasonable cost. The cheapest method of obtaining pen manure is from pens on the cultivation, and with a supply of green fodder within reasonable distances a small profit on the stock might also be expected. Experiments are being made with a combination of pen manure and artificial manures with a view to lessening the cost.

The efficiency of the cold storage arrangements on the Royal Mail Steamers has been conclusively proved over a sufficiently long period, and there are now no less than fifteen records within a year of the sales amounting to 100 per cent. of the shipments, and on the

total for the year the sales have amounted to $98\frac{1}{2}$ per cent. of the shipments showing only $1\frac{1}{2}$ per cent. of loss in transit. Growers of bananas have therefore only this small possible risk of loss on the shipments.

Making allowances for all reasonable risks in connection with banana growing a satisfactory profit should be expected at the present price of bananas.

I have the honour to be, Sir,

Your obedient Servant,

The Hon'ble
Acting Colonial Secretary.

P. CARMODY,
Director.

THE DIRECTOR,
Department of Agriculture.

SIR,

I beg to submit a report on the Banana Cultivation at Valsayn.

The cultivation of bananas was started in the month of July, 1904, when 25 acres were planted, 20 acres with the Gros Michel variety and 5 acres with Governors. The land selected was a portion of Valsayn estate situated on the Curèpe road, the soil consisting of a deep sandy loam which had been in cane cultivation for a considerable number of years, until 1900. The bananas were planted on the old cane beds 13 by 11 feet apart and the cultivation carried out was weeding, forking, and draining; a dressing of 10 tons of pen manure was applied per acre.

Reaping was started on October 23rd, 1905, and the fruit was sold to the British West Indian Fruit Company who were then offering 42 cents per bunch of 9 hands, 8 hands being counted as three-quarter, and 7 hands as a half bunch. The result of the first year's working was very promising, and in 1906 it was decided to put a further 51 acres in cultivation, half in Gros Michel and half in Governors. The cultivation continued to do well until November, 1906, when a wind storm uprooted about 20 acres of Gros Michel almost ready for the market, the following year the industry received another set back by the British West Indian Fruit Company objecting to the purchase of the Governor variety, this caused a heavy loss at the time, which made us try the American market, but as the Governor was then not known on that market, and the facilities for fruit carrying by the steamers available being not complete, this venture was not successful. Our market continued very unsatisfactory for some time, the Fruit Company complained that the Governor variety did not carry as well as the Gros Michel, and did not pay the cost of crating, and as crating also increased the cost of freight the sale of Governors for a time was almost impossible and caused us to turn our attention to the planting of Gros Michel, which however soon received a check by the appearance of disease in that variety, which

became so severe that the cultivation of Gros Michel had to be abandoned entirely. A start was then made to ship our Governors uncrated on consignment to the Fruit Company at Southampton, this arrangement threw any loss on the shippers, but has been found to work on the whole satisfactory, and with the improved carrying facilities of the Royal Mail Steamers will, I think, continue so, and I am pleased to say that now if care is taken in the grade of fruit sent, and the fruit otherwise carefully handled, the difficulty of shipping the Governor variety has been overcome, this is gratifying especially as this variety has more disease resisting qualities than the Gros Michel, also that the yield per acre is heavier and owing to its short stumpy nature does not suffer from wind.

The banana disease is still prevalent, but with the steps now taken, I am hopeful that it can be successfully combated, fields that are attacked are partly abandoned, diseased trees cut down and limed, the beds banked up and stumps buried, the field afterwards planted in potatoes, after two crops of potatoes are reaped, which give a small profit on the working, the field is replanted with the Governor variety. Fields treated in this manner are comparatively free of disease, two fields side by side originally planted in Gros Michel and which had died out from disease were replanted with Governors, one was treated as described, and the other was simply replanted, the first shows scarcely any signs of disease, while the other has had to be banked and replanted.

This disease has made its appearance in other countries of late, and has greatly diminished their output, amongst the steps taken by them to combat the disease is the planting up of disease resisting varieties.

The following table shows the reapings and receipt and expenditure to 31st March, 1910:—

Year ending	Hands reaped.	Receipts. $	c.	Expenditure. $	c.
31st March, 1906 ...	4,827	1,298	43	2,243	58
" " 1907 ...	5,992	976	28	3,777	10
" " 1908 ...	23,176	3,645	92	3,883	23
" " 1909 ...	16,237	4,055	06	5,142	71
" " 1910 ...	22,953	4,048	96	3,428	48
	73,185	$ 14,024	65	$ 18,475	10

As will be seen by above figures very little headway has been made, owing the many causes already mentioned, but during these five years experience has been gained which I have good reason to hope will ultimately lead to success, and I am very pleased to state that returns lately have very much improved. Since 1st April this year to 22nd August, 14,691 stems have been shipped, which have

netted on the market $4,902 92 or more in four and a half months than has previously been received in twelve months, this is encouraging, and the following figures which will show the possible yield of one acre of well cultivated land planted in Governor banana, will also show the possibility of bananas being a remunerative crop.

A correct account of the reapings of the different fields has been kept lately, and from a field of Governors planted in 1904 containing 5 acres, which had received a dressing of 40–50 tons of pen manure per acre in 1908, the heavy return of 4,596 stems was reaped or 919 per acre, and as our stems shipped for the past year netted the low average of 21½ cents each on the market, even this small price will show a return of nearly $200 per acre while our average expenditure for the year was slightly under $40 per acre. I think this will conclusively prove that given fair conditions, the banana industry is worth fostering.

Since the planting of the Gros Michel has been entirely substituted by the Governor variety the yield per acre has very much increased. The Governor can be planted as close as 9 by 9 feet or even closer where a plentiful supply of pen manure can be had. Of late I have tried the rearing of cattle in open pens in the cultivation, and while the stock so penned show every sign of improvement, this very much lessens the cost of pen manure, and opens up a possibility of combining stock raising for the market in conjunction with the cultivation of bananas.

15 artificial manurial plots are at present being experimented on under the supervision of Mr. de Verteuil, Assistant Analyst, which will be of great assistance in determining the fertilizer most suited to the cultivation of bananas, experiments have already been made with pen manure, applications of 10—50 tons per acre have been tried, and I have come to the conclusion that 20 tons per acre applied every second year supply the soil with sufficient plant food for the growing of bananas.

JNO. MCINROY,

24th August, 1910. Manager St. Augustine Estate.

BANANA CULTIVATION.

From September 28th, 1909, to March 31st, 1910. (Six Months).

No. of Field.	Acreage.			Stems.				Total.	Average No. of Stems per acre.	Remarks.
	A.	R.	P.	9 hands.	8 hands.	7 hands.	6 hands.			
1 ...	10	3	27	332	411	385	72	1,200	109	Partly diseased.
2 (old) ...	5	0	0	672	784	729	80	2,265	453	From April 13th, 1909, to September 14th, 1909, 2,331 stems were reaped making a total for the year of 4,596=919 stems per acre. Heavily manured 1908.
2 (new) ...	4	1	16	60	334	421	69	884	203	Manured.
3 ...	10	3	8	208	877	1,448	263	2,796	258	,,
4 ...	12	2	14	483	379	369	100	1,331	105	Partly diseased.
5 ...	8	0	29	1,125	668	734	171	2,698	329	Partly manured.
6 ...	7	0	24	59	80	31	1	171	23	Badly diseased.
7 ...	3	3	19	239	261	329	65	894	231	Manured.
7 (reds) ...	2	0	0	...	...	...	...	553	276	
8 ...	2	3	6	175	66	12	...	253	90	Badly diseased.
9 ...	9	1	6	22	18	9	...	49	5	,, ,,
10 ..	4	0	20	79	21	6	...	106	25	,, ,,
11 ...	4	3	23	16	9	2	...	27	5	,, ,,
	85	3	32	3,470	3,908	4,475	821	13,227	153	

JNO. McINROY, Manager.

THE DIRECTOR,

Department of Agriculture

SIR,

I have the honour to submit a statement of Receipts and Expenditure on the cultivation of 86 acres of Bananas for six months ending 30th September, 1910.

As will be seen by the statement submitted the working for the past six months has proved very satisfactory, the output having very much increased as well as the price of fruit on the market.

The total stems shipped was 17,298 as against 10,532 for the same period last year, being an increase of 60 per cent. whilst the price increased 64 per cent., the stems sold netting 32 cts. on market as against 21½ cts. last year.

The field mentioned in my last report as having yielded 919 stems per acre for one year ending 31st March, has yielded 320 stems during the past six months, which netted on the market $102 40, whilst the expenditure incurred for the same period was $25 41, leaving a profit of $76 99 per acre; this yield may be considered very good, espe ially when the fact that the general yield of a banana cultivation is affected during the months of May, June and July by the droughts during the dry season, a better yield during the next six months may be expected.

The manurial experiment plots are looking promising, and reapings may be expected from them shortly. During the six months 20 acres have been pen manured, about 300 tons being obtained from open pens in the cultivation, at a cost of 53 cts. per ton, and the balance purchased from the Village @ 1/- per load of about 15 cwt.

The statement submitted shows all expenditure actually incurred. Management is charged under the head of Superintendent and Watchman which include Overseer, Overlooker, and Watchman, and amount to $4 50 per acre. Rent at the rate of $5 per acre has been added, and as the cost of planting and bringing one acre of bananas into bearing is practically $60, the capital involved may be taken at $5,160, which charged with 3 per cent. interest for the half year will reduce the profits to $3,074 36, a sum sufficient to pay all back rents and interests at 6 per cent. on the capital involved for the past five years on banana experiments, and leave the sum of $217 74 to be carried forward to profit and loss.

JNO McINROY,

Manager.

Banana Cultivation—(86 Acres).

Statement of Receipts and Expenditure for six months ending 30th September, 1910.

Receipts.	$ c.	$ c.
By Sale of 17,298 Stems Bananas to B.W.I. Fruit Coy. ...	5,622 94	
,, ,, 144 ,, ,, Locally	17 28	
,, ,, Potatoes	308 04	
Total	$5,948 26	5,948 26
Expenditure.	$ c.	
To Superintendents and Watchmen	387 12	
,, Weeding and Cutlassing	498 10	
,, Forking	54 41	
,, Digging Para Grass	26 59	
,, Manuring (including purchase)	538 06	
,, Pruning	63 20	
,, Digging diseased plants	23 80	
,, Repairing Road and Bridges	16 34	
,, Planting and reaping Potatoes	330 65	
,, Carting and reaping Banana	342 95	
,, Railway freight to Port	175 44	
,, Supplies	47 24	
Total amount spent	2,503 90	
Add Rent (6 months)	215 00	
Total	$2,718 90	2,718 90
Total amount of receipt over expenditure ...		$3,229 36

JNO. McINROY,
Manager.

Banana Cultivation.

Statement of Receipts and Expenditure for one year ending 31st March, 1910, on 86 acres of Banana at Valsayne.

RECEIPTS.	$ c.	$ c.
By Sale of 22,487 Stems Bananas Exported	3,966 20	
,, ,, 466 ,, ,, Locally	75 76	
,, ,, Banana Suckers	7 00	
	$4,048 96	4,048 96
EXPENDITURE.		
To Superintendent and Watchmen	634 00	
,, Weeding and Cutlassing	936 52	
,, Forking	46 90	
,, Digging Para Grass	114 66	
,, Manuring	259 01	
,, Pruning	98 47	
,, Supplying	109 85	
,, Draining	56 22	
,, Repairing Road and Bridges	47 77	
,, Propping Bananas	15 53	
,, Digging diseased plants	139 62	
,, Planting Potatoes	160 65	
,, Carting and Reaping and making Crates	559 36	
,, Supplies	25 52	
,, Railway freight to Port	224 40	
Total amount spent	3,428 48	
Add Rent	430 00	
Total	$3,858 48	3,858 48
Total amount of receipt over expenditure ...		$ 190 48

JNO. McINROY,
Manager.

THE DIRECTOR,

DEPARTMENT OF AGRICULTURE.

SIR,

I beg to submit a detailed statement of expenses incurred in connection with the experiments carried out on the 5-acre plot mentioned in my report on Banana Cultivation from 1st April, 1908, to 31st March, 1910:—

1908–9.		$ c.
Superintendents and Watchman	... ...	39 05
4 Weedings at $3.09 per acre	... ...	61 80
4 Prunings at 40 cents per acre	... ...	8 00
1 Forking at $4.40 per acre ...	... ...	22 00
200 tons Pen Manure, purchased, carted, and applied at 82 cents per ton	... ...	164 00
2,440 Stems reaped and railed to Port ...	...	85 40
Total cost of 5 acres	... ...	380 25
,, ,, 1 acre	... ...	76 05
By sale of 2,440 stems at 24 cents per stem	...	585 60
Less cost of 5 acres	... ...	380 25
Nett amount on 5 acres	... ...	205 35
,, ,, 1 acre	... ...	41 07
1909–10.		
Superintendents and Watchman	... ...	39 05
4 Weedings at $2.50 per acre	... ...	50 00
4 Prunings at 40 cents per acre	... ...	8 00
4,596 Stems Bananas reaped and railed to Port	...	160 86
Total cost of 5 acres	... ...	257 91
,, ,, 1 acre	... ...	51 58
By sale of 4,596 stems at 21½ cents per stem	...	988 14
Less cost of 5 acres	... ...	257 91
Nett amount on 5 acres	... ...	730 23
,, ,, ,, 1 acre	... ...	146 04

In my report already submitted I stated 'the cost was slightly under $40.00 per acre, this was the average cost of the whole cultivation (86 acres). It will be observed that the heavier the yield per acre the greater the cost for reaping and railage which is included in statement submitted and amount to $32.17 per acre for 1909–10.

I may mention that this field has produced 1,600 stems from 1st April this year to date.

JOHN McINROY,
Manager.

Government Farm,

29th Sept., 1910.

ST. AUGUSTINE ESTATE.

Shipments and Sales of Bananas, 1st April, 1909 to 31st March, 1910.

Shipped by "S. S."	Date.	No. of Stems Shipped.	No. of Stems sold.	Netted per Stem.		Total.		Amount paid R. M. Co. Freight.		Port Dues.		Paid Company for Handling.		B. W. I. Fruit Co. Commss'n.		Gross Sales.	
	1909.			$	c.	$	c.	$	c.	$	c.	$	c.	$	c.	$	c.
"Tagus" ...	Apr. 3rd ...	552	552		25	139	68	66	50	4	30	13	56	11	80	235	84
"Atrato" ...	" 17th..	549	549		24	136	66	63	62	2	78	13	82	11	42	228	30
"Magdalena"...	May 1st ...	464	464		40	189	18	50	42	3	80	10	94	13	40	267	74
"Orinoco" ...	" 15th..	822	822		12	103	08	76	36	4	44	17	88	10	62	212	38
"Oruba" ...	" 29th..	994	994		19	190	98	137	28	8	54	41	62	19	92	398	34
"Tagus" ...	June 12th..	879	847		22	186	36	94	38	6	72	19	58	16	16	323	20
"Atrato" ...	" 26th..	922	904		12	111	62	109	20	5	76	20	28	13	00	259	86
"Magdalena"...	July 10th..	1,805	1,804		16	293	82	220	72	14	88	38	44	29	88	597	74
"Orinoco" ...	" 24th..	796	796		29	233	90	103	70	6	58	30	16	19	04	393	38
"Clyde" ...	Aug. 7th...	763	763		33	258	12	92	02	5	34	16	56	19	60	391	64
"Thames" ...	" 21st..	924	923		28	256	74	110	60	6	16	19	78	20	70	413	98
"Atrato" ...	Sept. 4th...	733	720		15	113	74	85	26	5	02	16	34	6	80	227	16
"Tagus" ...	" 19th..	520	373		16	60	12	47	74	2	38	7	94	2	06	120	24
Car. forward...	...	...	...		...		...		...		...		...		...		...

ST. AUGUSTINE ESTATE

Shipments and Sales of Bananas, 1st April, 1909, to 31st March, 1910.—CONTINUED.

SHIPPED BY "S.S."	Date. 1909.	No. of Stems Shipped.	No. of Stems sold.	Netted per Stem.	TOTAL.	Amount paid R.M. Co. Freight.	Port Dues.	Paid Company for Handling.	B.W.I. Fruit Co. Commss'n.	Gross Sales.
				$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
Brt. forward...										
"Oruba" ...	Oct. 2nd	729	695	14	100 44	87 82	4 42	16 66	11 04	220 38
"Magdalena"...	,, 16th	623	623	10	68 40	79 06	4 14	15 28	8 80	175 68
"Clyde" ...	,, 30th	860	847	7	63 18	107 60	6 74	18 74	10 32	206 58
"Thames" ...	Nov. 13th	886	886	15	134 68	111 90	7 38	21 28	14 48	289 72
"Atrato" ...	,, 27th	633	633	16	104 22	82 48	6 68	16 08	11 04	220 50
"Tagus" ...	Dec. 11th	733	733	15	114 24	92 34	6 08	19 00	12 20	243 86
"Oruba" ...	,, 25th	613	613	16	101 54	70 98	5 32	15 76	10 72	214 32
	1910.									
"Magdalena"..	Jan. 8th	771	771	21	163 18	98 56	7 66	19 00	15 18	303 58
"Thames" ...	,, 22nd	916	916	21	200 10	114 64	8 00	20 62	18 10	361 46
"Clyde" ...	Feb. 5th	761	734	31	229 46	116 60	7 70	17 00	19 54	390 30
"Ortona" ...	,, 19th	1,342	1,332	21	292 46	197 78	13 02	21 06	28 14	562 46
"Nile" ...	Mar. 5th	1,427	1,409	32	456 34	222 84	14 46	31 18	38 16	762 98
"Tagus" ...	,, 19th	1,360	1,350	29	399 78	205 46	12 88	37 84	34 52	690 48
Totals ...	...	22,377	22,063	...	$ 4,702 02	$ 2,845 86	$ 181 18	$ 546 40	$ 426 64	$8,702 10

Average nett price per stem ... ... 21½ cents.

Statement of work carried out on the Banana Experiment Plots to date.

17 Plots containing 50 stools each and measuring 135′ x 22′ = 2,970 square feet.	Date.			Manures applied.	Rate.
	Pruned and Weeded.	Forked.	Manured.		
No. 1	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,				
	27th August, ,,				
No. 2	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,			Potassium Sulphate ...	200 lbs. ,,
	27th August, ,,		17th June, ,, ...	Ammonium Sulphate ...	200 ,, ,,
				Bone Meal	400 ,, ,,
No. 3	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,			Sodium Nitrate ...	200 lbs. ,,
	27th August, ,,		17th June, ,, ...	Potassium Sulphate ...	200 ,, ,,
				Basic Slag	400 ,, ,,
No. 4	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,			Potassium Sulphate ...	200 lbs. ,,
	27th August, ,,		17th June, ,, ...	Ammonium Sulphate ...	250 ,, ,,
				Superphosphate of Lime ...	450 ,, ,,
No. 5	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,			Kainit	400 lbs. per acre.
	27th August, ,,		17th June, ,, ...	Sodium Nitrate ...	200 ,, ,,
				Superphosphate ...	400 ,, ,,
No. 6	15th April, 1910	20th April, 1910 ...	7th May, 1910 ...	Pen Manure	20 tons per acre.
	13th June, ,,			Potassium Chloride ...	200 lbs. ,,
	27th August, ,,		17th June, ,, ...	Sodium Nitrate ...	200 ,, ,,
				Superphosphate ...	400 ,, ,,

Statement of work carried out on the Banana Experiment Plots to date.—*Continued.*

17 Plots containing 50 stools each and measuring 135′ x 22′ = 2,970 square feet.	Date.			Manures applied.	Rate.
	Pruned and Weeded.	Forked.	Manured.		
No. 7	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	7th May, 1910 ... 17th June, ,, ...	Pen Manure ... ... Calcium Cyanamide ...	20 tons per acre. 300 lbs. per acre.
No. 8	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	7th May, 1910 ... 17th June, ,, ..	Pen Manure ... ... Calcium Nitrate	20 tons per acre. 300 lbs. per acre.
No. 9	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Potassium Sulphate .. Ammonium ,, ... Bone Meal	200 lbs. per acre. 200 ,, ,, 400 ,, ,,
No. 10	15th April, 1910 13th June, ,, 27th August ,,	20th April, 1910 ...	17th June, 1910 ...	Sodium Nitrate ... Potassium Sulphate ... Basic Slag	200 lbs. per acre. 200 ,, ,, 400 ,, ,,
No. 11	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Potassium Sulphate ... Ammonium Sulphate ... Superphosphate of Lime ...	200 lbs. per acre. 250 ,, ,, 400 ,, ,,
No. 12	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Kainit ... ... Sodium Nitrate ... Superphosphate ...	400 lbs. per acre. 200 ,, ,, 400 ,, ,,

Statement of work carried out on the Banana Experiment Plots to date.—*Continued.*

17 Plots containing 50 stools each and measuring 135′ x 22′=2,970 square feet.	Date.			Manures applied.	Rate.
	Pruned and Weeded.	Forked.	Manured.		
No. 13	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Potassium Chloride ... Sodium Nitrate ... Superphosphate ...	200 lbs. per acre. 200 ,, ,, 400 ,,
No. 14	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Calcium Cyanamide ...	300 lbs. per acre.
No. 15	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ..	Calcium Nitrate	300 lbs. per acre.
No. 16	15th April, 1910 13th June, ,, 27th August. ,,	20th April, 1910 ...	17th June, 1910 ..	Lime	10 cwt. per acre.
No. 17 (Diseased)	15th April, 1910 13th June, ,, 27th August, ,,	20th April, 1910 ...	17th June, 1910 ...	Calcium Cyanamide (on diseased patch)	300 lbs. per acre.

Banana Flour.

THERE is an increasing demand for Banana flour owing to its nutritious properties being combined with a pleasant appetising flavour unusual among starchy foods.

The Department recently received an order for a shipment, but the price* quoted was no higher than the present market value of the banana itself. After deducting the cost of manufacturing the banana flour the producer would receive a very inadequate remuneration.

Some time ago an experiment was made for the Department to ascertain if sliced dried bananas could be prepared profitably for sale at £16 a ton, and the result of this experiment showed that at this price each bunch of bananas would nett only 11·3 cents. An industry in banana flour, or in sliced dried banana, would be a very desirable one in this Colony if only remunerative prices could be obtained.

The Finance Committee on the Fruit Industry.

The following Resolution was passed by the Finance Committe at a Meeting held on 14th October, 1910:—

> "That it is absolutely essential to the commercial and agricultural interests of the Colony, and in particular its fruit industry, that direct and regular passenger, freight and mail steam ship communication should be maintained with the United Kingdom; that His Excellency the Acting Governor should urge upon the Secretary of State for the Colonies, that the question of an Imperial subsidy in aid should be reconsidered; and that this Committee is of opinion that this Colony should contribute to any subsidy which would induce the Royal Mail Steam Packet Company to continue its present transatlantic service, such contribution not to exceed either £5,000 per annum, if Trinidad continues to be a port of call of the transatlantic boats, or £15,000 per annum if Trinidad be made headquarters."

Fruit Exports—Values.

1904–5	£ 803
1905–6	4,259
1906–7	4,682
1907–8	11,076
1908–9	16,081
1909 (to December 31) ...	20,836

—(*Customs Trade Statistics*).

* A higher price has since been offered and is now under consideration.

Market Prices Bananas.

		Oct., 1910.	Oct., 1909.
	Per bunch ...	6/- to 13/-	5/- to 9/-
Jamaica	—cwt.	...15/-	
	crated	... 9/-	
Costa Rica	—cwt.	...13/- to 14/-	
	crated	... 8/-	
Canary Islands	—bunches	...10/- to 12/-	

Section V.—GENERAL FORESTRY.

The weight of Cedar and Cyp Seeds.

The following observations have been recently made on the weight of selected Cedar (*Cedrela odorata, L.*) and Cyp (*Cordia* sp. L.), and it is thought that they may be of some interest to planters and others.

Cedar (*Cedrela odorata, L.*)—Cedar seeds were collected in May, 1910. The unopened capsules were gathered from branches on which one or two capsules had already opened and shed their seeds. The capsules were spread in a thin layer on trays having perforated zinc bottoms in an airy room where they gradually opened allowing the seeds to fall out. The seeds were carefully selected by winnowing only the heaviest seeds being retained.

In the middle of July, about 2 months after collection, 4,000 seeds were counted out in lots of 500 and weighed with the following results :—

500 seeds weighed	...	205	grains.
500 ,, ,,	...	206	,,
500 ,, ,,	...	205	,,
500 ,, ,,	...	213	,,
500 ,, ,,	...	205	,,
500 ,, ,,	...	201	,,
500 ,, ,,	...	205	,,
500 ,, ,,	...	203	,,
4,000 ,, ,,	...	1,643	,,

Average weight per 100 = 41 grains.

Cyp (*Cordia*, sp. L.)—Cyp seeds were collected in May and June. The panicles bearing the seeds were picked and laid out on similar trays to those used for cedar. Those collected in May contained but few sound seeds, having been picked before they were ripe. Those collected in June gave much better results. The seeds after being allowed to dry were hand picked, only full seeds were retained.

In July 1,000 seeds were counted out in lots of 100 and weighed, giving an average of 24 grains per 100. Seven of the hundreds weighed exactly 24 grains, two weighed 23 grains, and one 26 grains.

It is proposed to make further observations next year with both Cedar and Cyp seeds and also with other seeds of forest trees.

C. S. ROGERS,
Forest Officer.

19th August, 1910.

Notes.

FRESH HEVEA SEEDS (Longdenville)—

Between 6 and 7 weigh 1 oz.

HONDURAS MAHOGANY—

330,000 seeds have been ordered for this Colony, and are expected to arrive at an early date.

Section VI.—RUBBER.

Castilloa Rubber.

Report from the Director of the Imperial Institute.

WITH reference to your enquiries on the subject of Castilloa rubber, I now send you the following information on the points which you raised.

The following analyses of Castilloa rubber derived from trees of different ages were made by Weber, whose experiments were conducted at Las Cascadas on the Isthmus of Panama:

	Percentage of Resin present.
Rubber from tree 2 years old	42·33
,, ,, ,, 3 ,, ,, ...	35·02
,, ,, ,, 4 ,, ,, ...	26·47
,, ,, ,, 5 ,, ,, ...	18·18
,, ,, ,, 7 ,, ,, ...	11·59
,, ,, ,, 8 ,, ,, ...	7·21

From these results Weber concluded that Castilloa trees should not be tapped until they are 8 years old and this view is generally supported by planters in Mexico and Central America. Olsson-Seffer states that in Mexico Castilloa trees reach a tappable size in from 6 to 10 years according to the locality; at the La Zacualpa plantation trees are tapped in their 7th year provided that they have attained a girth of 28 inches at 3 feet from the ground, and in the 8th year all trees of 25 inches circumference are tapped.

For comparison with the above figures the results of the examination at the Imperial Institute of a number of samples of Castilloa rubber from Trinidad may be quoted :

Age of trees.		*Percentage of Resin in Rubber.*
4 years	... ...	64·1
4½ ,,	... ...	52·6
4½ ,,	.. ...	56·2
4½ ,,	... ...	49·3
6 ,,	... ...	20·6.. "Verdant Vale."
7½ ,,	... ...	52·0...Trees of small size overgrown by Hevea trees—on lands belonging to Botanical Department.
7½ years	... ...	36·9
Over 12 years ...	...	13·8
12 years and over	...	8·3
14 to 16 years ...	...	8·2...Prepared by Weber's process.
17 years	... ...	23·0..."Tortuga."
"Old trees" ..	...	15·8
Age not stated *	...	21·7..."Louis d'Or."
,, ,,	...	37·2..."Monte Christo."
,, ,,	...	15·6..."Richmond."
† ,, ,,	...	6·2..."Richmond" Estate, Tobago.
,, ,,	...	28·6...Prepared by Mr. Smith's process.

A comparison of these figures with those already quoted from Weber shows that the rubber furnished by Castilloa trees in Trinidad is much more resinous than that obtained from trees of the same age growing at Las Cascadas. Only in three out of 17 analyses does the percentage of resin in Trinidad Castilloa rubber fall below 13·8 per cent. ; in two of these cases the trees ranged from 12 to 16 years old and the percentages of resin were 8·3 per cent. and 8·2 per cent., respectively, whilst in the third case, in which the age of the trees was not stated the resin was as low as 6·2 per cent. The percentage of resin in Trinidad Castilloa rubber appears to vary considerably, since the rubber obtained from 17-year old trees on the Tortuga Estate contained 23 per cent. of resin.

A number of varieties of *Castilloa elastica* are stated to occur in Mexico and Central America, and Cook has described a number of these as separate species. *e.g.*, *Castilloa fallax*, *C. lactiflua*, *C. nicoyensis*, and *C. panamensis*. According to Olsson-Seffer, nine fairly distinct forms of *C. elastica* can be recognised in Mexico, some of which are specially suited to the conditions prevailing in certain districts. Thus it is stated that Castilloa plants raised from seed obtained from trees growing on the Atlantic side of Mexico, where

* 10 Years. † 20 Years.

there is an almost continuous rainfall, will not succeed on the Pacific slopes, where there is a distinct dry season of about six months.

It has been alleged that some of these varieties of *C. elastica* only furnish very small yields of rubber, but no information appears to be available regarding the quality of the product. Experiments with the different varieties are however in progress in Mexico in order to determine their relative value as sources of rubber.

An investigation of the Castilloa trees growing in Trinidad might be made with a view to the selection for seed purposes of any trees which give a large yield of rubber containing a low percentage of resin. At the same time seed from Castilloa trees of proved value might be obtained from plantations in Mexico, in order to ascertain whether the trees grown in Trinidad will furnish rubber of good quality, or whether the local conditions of climate and soil in the island favour the formation of a resinous rubber.

The method adopted for the preparation of Castilloa rubber on the plantations in Mexico has been described by Olsson-Seffer (*see* pp. 94–96 of "Lectures on India Rubber" edited by Spence; the official account of the conference held in connection with the International Rubber and Allied Trades Exhibition, London, 1908.) The method depends essentially on the creaming of the latex.

The centrifugal method introduced in Tobago by Mr. H. S. Smith, appears likely to give very good results when applied to latex containing a low percentage of resin.

PATENT CENTRIFUGAL MACHINE.

(Mr. Harry S. Smith's.)

Complete Specification.

"Improvements in or connected with the Manufacture of India-rubber and Apparatus therefor."

I, Harry Sidney Smith, of Caledonia, Tobago, West Indies, Gentleman, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to the separation of india-rubber from the latex which exudes from the trees.

Heretofore it has been proposed to separate the gum from the latex whilst the latter is in a liquid or semi-fluid condition by the action of centrifugal force. In practice, however, it has not been possible to carry out this process efficiently, for the reason that, owing to the consistency of the separated gum which is of less specific gravity than the other part of the latex, it is not possible to remove such gum by the ordinary skimming process within the drum, and also by reason of the fact that, if the drum is stopped the gum at

once commences to recombine with the more liquid separated portion. According to my invention, I overcome the difficulty by discharging the more liquid and impure portion of the latex during the rotation of the drum, so that practically the whole of the gum is separated and is obtained in the form of a sheet.

In a suitable arrangement for carrying out my invention I make use of a centrifugal machine, the bowl of which is fitted with valves which can be opened during the rotation of the bowl to discharge those portions of the latex which are of greater specific gravity than the gum, and which I have referred to as the "liquid"; this porous material may have applied to it a sheet of material such as canvas.

With this construction of apparatus, on the centrifugal machine being rotated and the latex introduced into the rotating bowl, the said latex is separated into the portions of different specific gravity, that is to say, the "liquid" and the gum, the pressure of the "liquid" within the closed bowl retaining the two portions in the separated condition. On the aforesaid valves being opened, the "liquid" passes out through the porous material, and through the valves, the gum then extending and collecting, or being applied against the inner surface of the porous material, or of the canvas or other lining in contact therewith. The machine is then stopped and the gum sheet removed from the bowl, together with the screen upon which it is applied, and from which it can subsequently be separated.

It is found in practice that it is impossible to completely separate the "liquid" from the other portion of the latex, so that there would always remain behind in the machine a certain proportion of impurities. It is for this reason that I employ the absorbent or porous layer, as this layer retains the small residum of "liquid" and prevents it passing into the next charge of latex.

To enable my invention to be fully understood, I will describe the same by reference to the accompanying drawing, in which:

Figure 1 is a section of the upper part of a centrifugal machine suitable for carrying the invention into practice, and

Figure 2 is a section on the line 2–2 Figure 1.

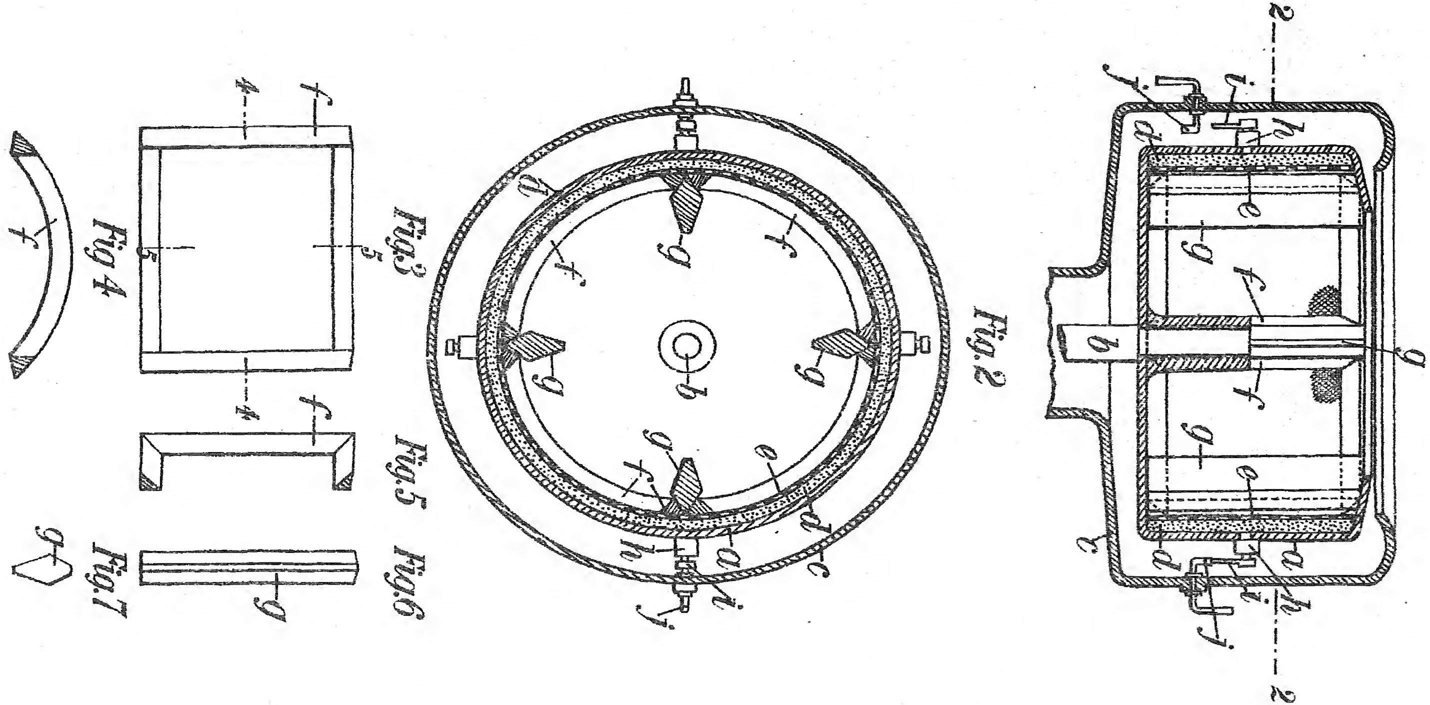
Figure 3 is a view of a frame which is employed in the apparatus.

Figures 4 and 5 are sections on the lines 4–4 and 5–5 respectively of Figure 3, and

Figures 6 and 7 are an elevation and plan of one of a series of locking pieces used in connection with the aforementioned frames.

(a) indicates a centrifugal bowl of ordinary construction mounted upon a spindle (b), and (c) a screen or casing around the same for collecting the "liquid" discharged from the drum.

(d) is a layer of felt, earthenware, or other absorbent material, which is arranged in contact with the walls of the drums, and (e) is a layer or screen of canvas or other material which lies against this absorbent layer, and upon which the rubber is collected. (f), (f) are frames which serve to confine the layers (d) and (e) in their



This drawing is a reproduction of the Original on a reduced scale

proper positions, and (g), (g) are wedge pieces which are arranged between the ends of the said frames; and which, under the centrifugal action, tend to hold the same in their relative positions

(h), (h) are valves of any suitable construction which are arranged in the sides of the bowl, which valves are normally closed, but which at the required stage of the proceedings are adapted to be opened to allow the "liquid" which collects in the porous material to escape. As shewn the stem of each valve is provided with an arm (i), which is designed as the drum rotates, to come into contact with a projection (j) in the casing (c), the said projection being so arranged that when in one position as shewn at the left hand of Figure 1, it will be out of contact with the said arm, and when turned into another position, as shown at the right hand of Figure 1, will operate the said arm to open the valve.

In using the apparatus, the latex is introduced into the bowl in the usual manner, and under the centrifugal action the "liquid" or portion of heavier specific gravity finds its way towards the wall of the bowl, whilst the gum collects in the same way that the cream collects on the inner surface of the milk in a milk separator.

When this condition has been attained the device (j) is turned so as to come into contact with the arms (i) on the valves (h), with the result that the said valves are opened and allow the "liquid" to escape, whilst the gum remains.

When the drum is stopped and the frames (f) with the locking pieces (g) are removed, the said screen (e), with the gum upon it, can be taken out of the bowl and subsequently stripped from the said screen, which can be again used, the rubber being in the form of sheets of a very pure nature. The valves are closed before starting the machine, suitable hand-holes being formed in the casing (c) to allow of this.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is :—

1. In the treatment of rubber latex by centrifugal action, the employment of a drum in which the constituents of the latex are separated, and of means for discharging the "liquid" or heavier separated portion of the said latex, whilst the machine is still rotating, substantially as described.

2. In the treatment of rubber latex by centrifugal force the use of a centrifugal machine having upon the inner surface of the bowl, a layer which will absorb the "liquid" portion of the latex, and of a sheet or screen upon which the gum will collect, and from which it can be removed when the liquid has been discharged from the absorbent material, substantially as described.

3. A centrifugal machine for the treatment of rubber latex, provided with means whereby the contents of the drum can be retained as long as desired and then discharged through the periphery of the bowl whilst the latter is rotating, substantially as described.

Dated the 27th day of March, 1909.

Preparation of Rubber.

Read at the International Congress of Tropical Agriculture, Brussels, May, 1910.

The object of this paper is to bring to your notice a process which has recently been devised for the rapid separation of rubber from Latex. The machine is the invention of Mr. Harry S. Smith, a Rubber Planter in Tobago.

The machine makes use of the centrifugal principle with a peculiar adaptation of valves which admits of the escape of the dark. watery liquid, whilst the machine is running at a high speed. It has been hitherto used principally with Castilloa latex; and those who are familiar with the discolouration of this rubber through contact with the watery liquid for a short period, or during the drying process, will appreciate the advantages of this rapid and almost complete separation.

With this machine the rubber can be separated from the watery liquid within 20 minutes, and the resulting layer of rubber dried to less than 1 per cent. of water. It has only then to be subjected to the usual curing process.

A description of the process, and drawings of the machine, are given in the Specification (English Patent No. 7433 of 1909).

But having had an opportunity of working with this machine, I am in a position to add a few details to the description given in the specification.

In working, the machine is set running and a known volume of water is poured into the space between the outer rim of the bowl and the canvas screen to form a wall of water. The desired depth of the wall having been obtained, the latex fresh from the field is diluted with a certain proportion of water, and then slowly run into the middle of the bowl. The speed is then rapidly increased, and the machine run for about five minutes by which time the lighter rubber forms an inner layer. The water can now be drawn off, and the rubber made to rest on the canvas screen then spinning at a still more rapid rate until all the water has been removed. The rubber layer may then be washed on the screen with clean water, which is drawn off as before.

Or some of the watery liquid may be drawn off and clean water added at intervals, until every trace of the dark coloured liquid has been removed.

The rubber is then drawn on to the screen and dried as before.

In either method a nearly white rubber is obtained, which darkens but very slightly afterwards.

An important advantage in this machine is that chemical solutions can be used for the removal of the resins, which are present in large quantity in Castilloa latex from young trees.

Specimens of the Rubber prepared by this machine are submitted for inspection.

P. CARMODY.

Report on Castilloa Rubber from Tobago.

BY PROFESSOR WYNDHAM R. DUNSTAN, M.A., F.R.S., DIRECTOR.

THE specimens of Castilloa Rubber which are the subject of this Report were forwarded for examination to the Imperial Institute by the Director of Agriculture in Trinidad with letters No. 629 of the 26th June, 1909, and No. 2338R of the 6th September, 1909. It was stated that the Rubber had been prepared by a new centrifugal process, of which particulars were furnished by the Director of Agriculture.

DESCRIPTION AND RESULTS OF EXAMINATION.

(A.) Specimen forwarded with letter No. 629 of the 26th June, 1909. The sample bore the following label:—

"Department of Agriculture,

Castilloa Rubber prepared by a New Process.

Weight—48 grams. (From Tobago)—26/6/09."

It consisted of a square sheet of very pale rubber, clean and excellently prepared. The rubber was rather weak and much inferior in physical properties to good Para.

The results of the Chemical Examination were as follows:—

Moisture	...	... 0·1 per cent.
Caoutchouc	...	...70·7 ,,
Resin ...	...	...28·6 ,,
Proteids	...	... 0·5 ,,
Ash ...	...	... 0·1 ,,

The analysis shows that the rubber contains a high percentage of resin, which adversely affects its physical properties. The percentages of moisture, proteids and ash are extremely low and it is evident that the rubber has been very well prepared.

In view of the high percentage of resin present in this rubber it would be of interest to learn the age of the trees from which the latex was obtained.

Nos. 1, 2, 3, and 4.—Forwarded with letter No. 2338R of the 6th September, 1909.

No. 1.—"Not creamed, Spun within an hour of tapping. Trees 7–8 years old."—Weight 22 grams.

A thin sheet of pale brown rubber, clean and well prepared. The rubber was stronger than the previous specimen A, but still a little weak. The sample was too small for analysis.

No. 2.—"Creamed, spun same day. Trees 7–8 years old."—Weight 19 grams.

Very similar to sample A in appearance and physical properties. The sample was too small for analysis.

No. 3.—"Creamed, spun next day, trees 7–8 years old."—Weight 18 grams.

A thin sheet of brown rubber, rather soft and weak. The specimen was insufficient for chemical examination.

No. 4.—"Creamed and washed over and over again, spun next day. Trees 7–8 years old." With this specimen is included another which was labelled as follows: "Same as No. 4, but deposited on brass plate fitted inside bowl."

These two specimens had become firmly adherent and could not be separated from one another. They were exactly similar in appearance and were treated together. The united sample weighed 36 grams.

The rubber was pale, slightly sticky, soft and weak. In physical properties it was the worst of the series.

A chemical examination showed that the rubber contained 0·04 per cent. of moisture and 34·2 per cent. of resin. The quantity of material was not sufficient for complete analysis.

Commercial Value.

The specimens, with the exception of No. 4, were valued as follows:—

	A.—Fine thin sheet	6s. 10d. per lb.
No.	1.—Fine thin brown sheet ...	6s. 10d. „ „
„	2.— „ „	6s. 11d. „ „
„	3.—Thin sheet of rather soft character	6s. 4d. „ „

Specimen No. 4 was of very inferior quality on account of its soft and resinous character, and would realise a much lower price than those quoted for the other specimens.

On the date of the above valuations fine hard para was quoted at 8s. 10d. per lb. in London.

Conclusions.

Three of these specimens of Castilloa rubber, viz., Nos. 1, 2 and A, are of excellent quality and it is clear that the centrifugal method adopted for their preparation is capable of yielding very good results. Unfortunately the latex used for the experiments, judging by the composition of sample A is very resinous so that the resulting rubber is inclined to be soft and weak.

It is not possible from the examination of such small specimens to express any definite opinion regarding the best method of preparation. Sample No. 1, "Not creamed. Spun within an hour of tapping" was a little stronger than specimens No. 2 "Creamed, spun same day," and sample A both of which however were slightly superior to it in colour. No. 3. "Creamed, spun next day" was darker and much weaker than the preceding three specimens, while No. 4 "Creamed and washed over and over again, spun next day" was the worst specimen of the series as regards physical properties.

It would therefore appear that the specimens prepared from the latex on the day of collection are much superior to those in which the latex was kept until the next day. Further experiments will be necessary to determine whether it is advantageous to cream the latex before spinning. The creamed sample No. 2, is superior in colour to No. 1, which was not creamed and on that account was valued at 1d. per lb. more, but the rubber was not quite so strong as No. 1. Unfortunately the specimens Nos. 1 and 2 were too small

for analysis so that it was not possible to determine the composition of the "creamed" and "uncreamed" rubber for comparison. Larger samples (about half-pound each) of rubber prepared by these methods should be submitted for this purpose.

In view of the successful results obtained by this method of preparation, it would be of considerable interest if further experiments could be conducted on the same lines with latex derived from older trees, as such latex would probably be less resinous and would therefore yield a better product.

It may be further suggested that in dealing with latex containing considerable amounts of resin, it would be worth while to make some experiments with the object of devising a method of eliminating a portion of the resin, if possible during preparation; for example some of the resin might be held in solution by adding a dilute solution of caustic soda (2 or 3 per cent.) to the latex before spinning, taking care not to use sufficient of the alkaline solution to cause *rapid* coagulation. Specimens of rubber made from the latex without any addition and with varying quantities of the alkaline solution might be submitted for comparative examination. The rubber would require to be well washed after treatment with alkali.

Castilloa Rubber—(Tobago).

A NUMBER of samples of rubber from Tobago has been analysed to ascertain the percentage of resins they contain.

The following are some of the results obtained:—

Castilloa Rubber.			*Percentage of Resins.*
Trees, 3 years old	...	...	... 53·99
,, 7 to 8 years old	...	...	... 28·60
,, ,,	...	...	... 26·93
,, ,,	(latex boiled)	...	... 27·09
,, ,,	(,, not boiled)		... 27·31
,, ,,	(2½ % Soda)	...	... 15·29
,, 15 years ...	...	...	... 13·42
,, ,, ...	...	...	... 11·37

With the increasing age of the trees there is a fairly regular reduction in the percentage of resins found in the Rubber, but the rate of reduction is not rapid.

Castilloa Rubber from Tortuga Estate.

THE sample contains 13·09 per cent. of Resins.

JOSEPH DE VERTEUIL,
for Government Analyst.

Castilloa Rubber from trees 8 to 10 years old.—(Tobago.)

	528 *Sheet Rubber prepared by the creaming process.*	529 *Biscuit Rubber prepared by the "Elias" process.*
Water	4·23 per cent. ...	6·91 per cent.
Resins	17·33 ,, ...	16·66 ,,

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

Castilloa Rubber.—Trees 3 years old.

No. 653.

THE sample contains :—

Water	1·62
Caoutchouc	44·02
Resin	53·99
Impurities	0·37
	100·00

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

Tapping Castilloa Trees.

THE method now used in Tobago for the tapping of Castilloa trees is the result of about four years' experience. So far it seems to be the method best suited to the purpose. The injury done to the tree appears to be very slight, and the whole of the latex is secured at one tapping. Three tappings in a year is sufficient.

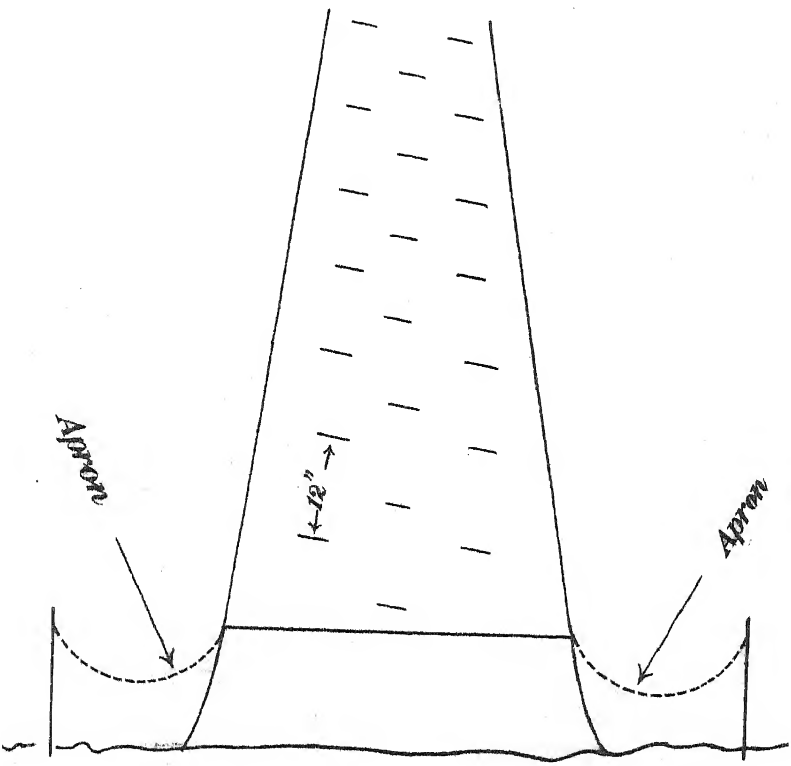
A chisel and mallet are used to make the cuts. The chisel is 1½ inches wide with a specially thin cutting edge. A fine clean cut is necessary. The chisel is held so as to point slightly upwards so as to give a cut which throws any rain water over the lower edge. In this way the wounds heal well.

Cuts are made in vertical lines from the base of the tree, about 12 inches apart, to a height of about 6 feet, and a second row is made about 3 or 4 inches horizontally from the ends of the first row. This is repeated round the whole girth of the tree. Each cut in the second row is placed intermediate between the cuts in the first row; the third cuts in the row are horizontally opposite those in the first row, the 4th opposite the 2nd, &c.

The latex is collected on a calico apron tied round the bottom of the tree and supported on its outer edge by four sticks. A basin is formed in this way into which the latex flows. Nails are also used to fix the apron close round the trunk if there are depressions.

After 20 minutes the latex is ladled from the apron into enamelled iron cups, and only enamelled vessels are used for storage. As much latex is collected from the tree as can be scraped off.

In 3 or 4 hours the scrap is dry and is then collected.



Tree showing Cuts in Vertical lines

Analyses of Trinidad and Tobago Rubbers made at Imperial Institute.

Constituents.	1902. Castilloa Elastica. Trees 4 years old.	1902. Castilloa Elastica. Old Trees.	1902. Funtumia Africana, Stapf. 3 Years Old.	1902. Funtumia Elastica, Stapf. 3 Years Old.	1903. 2. *Funtumia Elastica.* Trees 4½ years old, Coagulation by Alcohol. As Received.	1903. 2. Calculated on Dry.	1903. 3. *Castilloa elastica.* Trees 4½ years old, Coagulation by Alcohol. As Received.	1903. 3. Dry.	1903. 4. *Castilloa elastica.* Trees 4½ years old, Creamed, then coagulated with Alcohol. As Received.	1903. 4. Dry.
Moisture	0·54	0·41	20·7	15·1	29·05	..	10·03	...	4·02	...
Caoutchouc	33·60	81·90	39·3	80·4	60·02	85·03	37·01	41·03	41·01	43·00
Resin	64·10	15·80	60·	15·3	7·09	11·02	47·01	52·06	53·08	56·02
Dirt	1·70	1·90	0·7	4·3	2·04	3·05	5·05	6·01	0·08	0·08
Ash (included in Dirt) ...	0·35	0·34	...	...	1·37	1·94	1·47	1·64	0·31	0·32
					Valued at 2/6 per lb.					

1903.—Continued.	5. *Funtumia elastica.* Trees 4½ years old, Coagulated by Heat. As Received.	5. Dry.	7. *Castilloa elastica.* Air coagulation, drained on wire mesh. 4½ Years old. As Received.	7. Dry.	9. *Castilloa elastica.* Trees 12 years old, Alcohol coagulation. As Received. (Airdried before Analysis.)	9. Dry..	12. *Castilloa elastica.* 12 years old and over, washed and creamed latex, alcohol coagulated. As Received.	12. Dry.	Castilloa rubber—prepared by Weber's method (formalin to creamed latex). Trees 14–16 years. As Received.	Dry.
Moisture	21·02	...	8·00	...	15·02	...	2·02	...	9·05	...
Caoutchouc	68·05	86·09	40·08	44·04	70·01	82·07	89·01	91·02	82·06	91·02
Resin	7·09	10·	45·04	49·03	11·07	13·08	8·02	8·03	7·04	8·02
Dirt	2·04	3·01	5·08	6·03	3·00†	3·05†	0·05	0·05	0·05	0·06
Ash (included in Dirt) ..	2·08	2·66	1·24	1·34	0·79	0·93	0·25	0·25	0·26	0·29
	Valued at 2/2 per lb.				Valued at 2/4 per lb.		Valued at 2/9 per lb.		Valued at 2/9 per lb.	

† Exclusive of 46 per cent. bark removed before analysis.

Analyses of Trinidad and Tobago Rubbers (Continued.)

	Nos. 1 and 4 Para Rubber.		*Nos. 2 and 5 Para Rubber.*		*No. 10 Castilloa Rubber.*		*No. 11 Castilloa Rubber.*		*No. 15 Castilloa Block.*		*No. 17 Castilloa Sheet.*	
	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received Per cent.	Composition of Dry Rubber. Per cent.
	Tree 20 to 35 years.	Natural coagulation.	Tree 30 to 35 years.	Natural coagulation.	Trees 7½ years.		Trees 7½ years.		Trees 17 years.			
Moisture ...	2·0	...	3·7	...	2·05	..	2·5	...	8·00	..	0·08	...
Caoutchouc ...	93·0	94·9*	89·3	92·7*	46·04	47·05	57·6	59·1	69·02	75·02	76·01	76·07
Resin ...	3·1	3·2	3·6	3·7	50·06	52·00	36·0	36·9	21·02	23·00	21·05	21·07
Proteids ..	1·6	1·6	2·6	2·7	0·05	0·05	1·0	1·0	0·06	0·07	0·05	0·05
Ash ...	0·3	0·3	0·8	0·8	0·24	0·25	2 4	2·5	1·99	2·15	0·71	0·72
Sol. in Chloro..	...	93·6	...	87·4	Insol mat.	...	2·9	3·0	1·00	1·01	1·01	1·01
Insol. in Chloro.	...	1·3	...	5·3	,, ,,	...	...	...	..	...	...	...

	No. 19 Castilloa Sheet.		*No. 21 Castilloa Sheet.*		*No. 22 Castilloa Sheet.*		*No. 13 Funtumia Rubber.*		*No. 24 Balata.*			
	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.	Rubber as received. Per cent.	Composition of Dry Rubber. Per cent.
Moisture ...	0·01	..	1·00	..	0·01	...	3·02	...	1·08			
Caoutchouc ...	60·09	...	75·04	76·01	83·00	...	84·08	87·06	45·07			
Resin ...	37·02	...	20·04	20·06	15·06	...	8·07	9·00	44·02			
Proteids .	0·04	..	0·06	0·06	0·04	...	2·06	2·07	3·00			
Insol. Matter...	1·04	...	2·06	2·07	0·09	...	0·07	0·07	5·03			
Ash ...	0·37	...	2·17	2·19	0·51	...	0 71	0·73	1·28			

Local grown Para trees.

Quality of Latex.

Louis d'Or Estate, Tobago,
January, 18th, 1910.

Sir,

There is a question connected with the Rubber-planting industry which I think must be of great interest to all rubber planters in the West Indies at the present time, and upon which it is to be hoped some light will shortly be forthcoming.

Up to the present the principal, in fact practically the only rubber-producing tree planted in Trinidad and Tobago on any scale, has been the Castilloa. This tree has been considered the one best suited to the conditions, and the seeds and plants of which are easily obtainable.

Lately much has been heard of the splendid results attending the planting of Hevea in the East generally, results greatly exceeding those up to now obtained from Castilloa in the West Indies, and the question therefore arises, as to whether the Hevea may not be a more profitable tree to plant here than the Castilloa. The question to decide seems to be—*does the Hevea grow as well and does it produce a similar quantity and quality of Rubber in Trinidad as it has been found to do in Ceylon and Malay?*

As to the first point I think there is little doubt. Hevea has been planted in various localities in small quantities during the last few years, and I understand that Mr. Carruthers who knows the tree well in the East, is satisfied with the general growth and appearance of the trees he has seen here, it is on the second point that information seems very desirable.

Mr. Hart, the late Superintendent of the Botanic Station, has I think always maintained that the quality of Hevea rubber grown in Trinidad is *very inferior until the tree reaches the age of* 16–18 years, whereas in the East, good quality rubber is obtainable at *six years.*

I do not think that Mr. Hart's statement has been, so far, found to be incorrect, though of course no one has so far had much experience of the tree. But on the other hand, I understand that Mr. Carruthers has recently made trials of Hevea produced in Trinidad, and his investigations have confirmed Mr. Hart's statement. Also Mr. H. Smith, of this Island, who has treated Hevea latex in his newly invented separator, has arrived at the same conclusion.

The latex I believe on which experiments were recently made by Mr. Smith, was from trees 10–12 years old.

Several planters in this Island are at present considering the advisability of putting land under Hevea. It would therefore seem to be of the greatest importance to ascertain exactly the quality of the rubber produced from Hevea grown in Trinidad, at various ages,

and also the yield. I believe that the Government have recently ordered a large quantity of Hevea plants from Ceylon for distribution in the Colony.

Might I suggest, that before putting these plants at the disposal of the planters, thorough trials of the quality of latex produced in Trinidad be made in order to ascertain that the tree is really worth planting.

There are a good number of Hevea 8–9 years or thereabouts, now growing in the Botanic Gardens in Port-of-Spain, available for experiment. Also possibly planters who possess Hevea might be willing to place latex at the disposal of the Department.

I trust you will not consider this letter undue interference with what does not concern me. I have written because from the planters' point of view the matter *is pressing*. Planters have sunk a lot of money in Castilloa already in this Island, and we do not want to launch out into experiments with a new tree unless we are satisfied that there are reasonable prospects of success with it.

I am, Sir, yours faithfully,

T. L. M. Orde.

Professor Carmody, F.I.C.,
Department of Agriculture,
Port-of-Spain.

Para Rubber.—(Trinidad.)

The sample contains :—

Water ...	...	...	6·04 per cent.
Resins ...	...	...	2·08 ,,

Joseph de Verteuil,
Assistant Government Analyst.

Government Laboratory,
2nd September, 1910.

(Extract.)—Rubber Experiments at British Guiana.

General Summary.

The results of all our trials may be summarised as follows :—

1. *Castilloa elastica,* the Central American rubber tree, has failed at all stations.

2. *Funtumia elastica,* the West African rubber, is making some growth on the sandy loam at Onderneeming School farm, and tappings have been commenced. This kind has entirely failed on the heavy clay lands at the Botanic Gardens while at the Issorora Station it is thriving much better on the laterite hill slopes than on the mixed clay and pegass flat lands of the river bank. On the flat a

very large number of plants have died out, but the general appearance on the hill slopes would appear to warrant further experimentation on a limited scale.

3. *Hevea brasiliensis* has not grown at all well on the heavy clay lands at the Botanic Gardens which are typical of the front lands of the coastal district of the Colony, abandoned from sugar cultivation. It is doing fairly well on the clayey-loams at Onderneeming, and is growing very satisfactorily on the pegassy-clay bottom lands at the Issorora Station, but not so well on the laterite hill slopes. Some young plants on some of the clay soils at Christianburg are decidedly promising at the present time, although older trees have not grown so satisfactorily.

4. Hevea requires to be thoroughly protected from the wind if the best results are to be expected. The strong and constant winds of the coast land produce a reddish shrivelled appearance of the leaves and frequent leaf fall. This retards greatly the growth of the plants.

5. Hevea in some localities branches naturally at from 12 to 20 feet, but our experience indicates that topping at 12 to 15 feet in sheltered favourable places and at 10 feet in wind-swept situations is to be recommended if a uniform stand is required. After branching, a relatively greater increase of girth takes place than previously, and therefore the obtaining of as early branching as possible should be aimed at. If planted 20 feet by 20 feet, a height of 12 to 15 feet would be sufficient before topping, but in closer planted cultivations the trees should be allowed to grow to a greater height.

6. Hevea grows slowly under shade, but in the open it has made at Issorora growth that compares favourably with growth reported from the East and other countries, when it has been planted in well-drained, fully cleared land or fairly well protected from wind. When planted in cleared lines through the forest the growth has been irregular.

7. Sapium has grown vigorously on the pegassy clay lands of the Issorora Station. Some good trees are also growing on 'Mora-reef' soil at Christianburg. On the coastal lands, constantly swept by wind, as exemplified by the experiments at the Botanic Gardens, it has practically failed, small bushy plants, liable to scale attacks, only resulting. When planted in fully cleared land, well drained, it has made excellent growth in the point of girth and appears to be promising for growth on such types of soil as that at the Issorora Station.

8. Sapium similarly to Hevea, will not grow at all satisfactorily under shade or in undrained land.

9. Sapium requires very careful attention in regard to pruning from its earliest stages if well formed trees are desired. A clean, even stem of at least 8 feet should be aimed at, and big branches should be removed from the tops of the trees in windy situations.

10. Scale insects affect Sapium to some extent but they can be controlled by spraying with suitable insecticides. This liability to scale, should induce cultivators of this tree to plant in 50 to 100 acre sections with good forest belts between the different sections.

11. Tapping experiments with Sapium have not yet been carried on for a sufficient length of time to warrant expressions of opinion as to possible returns from this tree. Systematic experiments are in hand and definite information should soon be available.

12. The detrimental effect that constant winds have on both Hevea and Sapium indicate that in laying out large plantations, cultivators should lay them out in sections with good protective forest belts in between the different sections, and on no occasion should the tops of the hills be bared. A well-laid out plantation should have protective forest belts as wind breaks in order to keep wind out of the cultivation. This policy is also most desirable from an estate plant—sanitation point of view.—(Progress Report, *Department of Science and Agriculture.*)

World's Production of Rubber.

Tons.					
1906—65,000,	of which	531	tons are	from	plantations.
1907—69,000,	,,	1,133	,,	,,	,,
1908—65,000,	,,	2,000	,,	,,	,,
1909 69,000,	,,	4,000	,,	,,	,,

—(*Rubber World.*)

Trinidad and Tobago Rubber Exports.

				Value.
1904–5	...	3,659 lbs.	...	£ 549
1905–6	...	Nil.	...	
1906–7	...	1,067 lbs.	...	174
1907–8	...	4,444 ,,	...	603
1908–9	...	2,146 ,,	...	308
1909 (to 31 Dec.)		13,234 ,,	...	1,388

—(*Customs Trade Statistics.*)

Castilloa Rubber—Mexican Yield.

In the Soconusco district the trees are planted 280 to the acre, and the yield from each tree 6 to 8 years old is $3\frac{1}{2}$ ozs. per tree per annum. 350,000 trees are included in this calculation.

Average Net Imports and Prices of Raw Rubber—(Great Britain.)

Five years.	*Quantity.* Cwt.	*Value.* £ *	*Price per cwt.* £ s. d.
1855–9 ...	18,100	113,000	6 5 0
1860–4 ...	38,200	312,000	8 3 0
1865–9 ...	70,200	594,000	8 9 0
1870–4 ...	94,500	1,042,000	11 0 0
1875–9 ...	75,000	766,000	10 4 0
1880–4 ...	93,100	1,386,000	14 17 0
1885–9 ...	98,900	1,145,000	11 11 0
1890–4 ...	128,200	1,541,000	12 0 0
1895–9 ...	166,400	1,889,000	11 10 0
1900–4 ...	173,500	2,305,000	13 5 0
1905–9 ...	274,500	3,913,000	14 5 0
Six months to June, 1910	241,500	7,832,000	32 8 0

—*Financial News.*

[Extract.]—A Fungus on Para Rubber Trees.

The fungus proves to be an undescribed species of Eutypa, and will be called E. caulivora. It is probably a true parasite, judging from what is known respecting other species of Eutypa a constant feature of which is that the fungus persistently remains in a vegetative—and thus aggressive—condition so long as its host remains alive, and only comes to the surface to produce fruit when the host is absolutely dead. The numerous black streaks, deep in the wood of the specimen sent, are produced by the mycelium of the fungus, which in all probability permeated the whole of the wood, and had been at work for a considerable period of time. Such a development of mycelium is unknown as a *post mortem* result. (George Massee, 6/4/10.) Dr. Prain adds: "I do not like the look of the thing at all."—(*Straits Agricultural Bulletin through Rubber World.*)

* C. i. f. values at Ports.

Section VII.—CEREALS AND STARCHES.

Cassava Starch.

The Company that started in Jamaica about a year ago to manufacture Cassava Starch has ceased business. They offered only 25 cents per cwt., but the Planters refused to accept less than 37 cents.

Soy Bean. (*Glycine Hispida.*)

This Bean has been planted at *St. Augustine* and at the Botanic Station, St. Clair. The growth at *St. Augustine* has been satisfactory, and further experiments will be made.

The following gives brief information respecting this valuable fodder plant:—

[Extract.]—Soy Beans.

The soy bean (*Glycine hispida*) sometimes called the soya bean is a leguminous plant, and a native of south-eastern Asia. There are many varieties known in Japan, China, Tibet, and the temperate portions of the Himalaya. In the United States the varieties known and grown are yellow, black, green, and brown soy, so named from the colour of their seeds, with in addition, Etampes soy, which has seed like yellow soy, but grows to a height of over two feet, all the other varieties being only from one to one and a half feet high. The soy bean requires about the same temperature as maize, and it may therefore be capable of growth in some of the southern and eastern parts of England. The Board have arranged for some experiments to be conducted with beans obtained from Japan.

According to the *United States Farmers' Bulletin* (Nos. 58 and 97) the methods of cultivation are similar to those required for ordinary field beans. It thrives best in soils of medium texture, well supplied with lime, potash and phosphoric acid. Like other leguminous crops, it accumulates nitrogen in the nodules on its roots and thus enriches the soil for the next crop. It endures drought well, and is not easily injured by excess of moisture.

The early varieties are best for seed crops, and the medium or late varieties for hay or forage. Seed may be planted at any time during the spring and early summer, but preferably as soon as the ground becomes thoroughly warmed. One-half to three-quarters of a bushel to the acre may be drilled, but about one-quarter of a bushel more if sown broadcast.

Little cultivation is needed when growing for forage, but if grown for beans, weeds must be kept down. The crop should be cut for hay when in the late bloom or early podding stage; for ensilage the crop can be cut later, but it is better to cut before the pods begin to ripen; for green forage, cutting may begin earlier and continue rather later than for either hay or ensilage; the crop may be cut for seed after the pods become about half-ripe.

Owing to its coarse habit of growth, the soy bean is somewhat difficult to make into hay in moist climates, and the plant is liable to lose a large part of its leaves, but there can be no question as to its high feeding value when cut at the right season and properly cured.

It is probably best used as green forage. The great variation in the season of maturity of the different varieties makes it possible to have a succession of forage throughout the greater part of the summer and autumn. It is stated to be excellent for dairy cattle, though stock do not always relish it at first.

It has also been successfully made into silage in the United States.—(Journal of the *Board of Agriculture and Fisheries.*)

Soy Bean—Analysis of.

Water	11·0
Albuminoids	35·3
Starch and Sugar	26·0
Fat	18·9
Fibre	4·2
Ash	4·6
	100·0

—*Food Grains of India (Church).*

Section VIII.—FIBRES.

Cotton Exports.

	lbs.	£
1904–5 ...	1,577 ...	70
1905–6 ...	14,951 ...	434
1906–7 ...	11,077 ...	286
1907–8 ...	11,300 ...	280
1908–9 ...	13,503 ...	681
1909 (to Dec. 31)...	8,536 ...	463

Section IX.—SOILS.

Analysis of Tamana Soils.

TAMANA,

27th October, 1909.

THE SECRETARY,

Board of Agriculture.

SIR,

I have the honour to forward samples of Tamana soil from places where the 'Bocare' immortel are gradually dying, their death being due, according to popular opinion, to *excess of lime* in the soil.

No. 1. Top soil, humus only removed.

,, 2. Soil from depth of *two and a half to three feet.*

,, 3. Subsoil from *depth of four feet.*

The above were taken from a field where the cacao *appears to be thriving* and bearing well in spite of the *gradual dying* of the shade.

4. Subsoil from *depth of three feet* from "Santa Rita" estate.

5. Stones coated with lime from ravine which passes *through field* where practically all *the 'Bocare' immortel are dead* the 'Anauca' however still *seem to be thriving.*

L. A. BRUNTON,

Agricultural Inspector.

REPORT.

SAMPLE OF SOIL NOS. 1, 2, 3.

THESE samples were taken from the Tamana district, from a field where, the Agricultural Inspector reports, the Bocare Immortel are dying out, but the cacao trees appear to be thriving and bearing well.

No. 1 surface soil is a brown coloured clay which is deficient in phosphates.

No. 2 is a reddish clay containing a large proportion of oxide of iron, it is very poor in phosphates.

No. 3 subsoil is a greyish clay spotted with a fair quantity of shining particles of calcium sulphate or gypsum.

The detailtd results of analysis are as follows.

The air-dried samples contain :—

	No. 1 Surface soil.	*No. 2 Soil 2 to 3 ft.*	*No. 3 Subsoil 4 ft. deep.*
Water	3·24	5·48	4·38
Volatile matter and combined water ...	8·62	8·32	8·02
Mineral matter ...	88·14	86·20	87·60
	100·00	100·00	100·00

SOILS.—*Continued.*

PERCENTAGE COMPOSITION OF SAMPLES DRIED AT 100c.

	No. 1 Surface soil.	*No. 2 Soil 2 to 3 ft.*	*No. 3 Subsoil 4 ft. deep.*
Volatile matter and combined water ...	8·909	8·802	8·387
Oxides of iron and alumina	9·532	14·919	11·341
Lime	·295	·390	3·974
Magnesia	·331	·462	2·570
Potassium oxide ..	·157	·213	·287
Sodium oxide	·076	·096	·091
Phosphoric anhydride ...	·079	·020	·100
Sulphuric anhydride ...	·060	·064	2·446
Carbonic acid	—	—	4·526
Insoluble silica and silicates	80·561	75·034	66·278
	100·000	100·000	100·000

The lime and magnesia in sample "No. 3 Subsoil 4 feet" are present partly as sulphate and partly as carbonate in the following proportions :—

Calcium sulphate ($CaSO_4$, $2H_2O$) ...	4·700	per cent.
Calcium carbonate	4·053	,,
Magnesium sulphate ($MgSO_4$, $7H_2O$).	·465	,,
Magnesium carbonate	5·237	,,

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

NO. 4.—SUBSOIL 3 FEET DEEP FROM "SANTA RITA" ESTATE.

This sample was divided into three parts which were analysed, separately, with the following results :—

	"A" *Pulverised portion.*	"B" *Soft Stones.*	"C" *Hard Stones.*
Insoluble silica and silicates ...	10·47 per cent.	3·58 per cent. ...	2·28 per cent.
Oxides of iron and alumina ...	2·80 ,,	1·44 ,,	1·04 ,,
Calcium carbonate ...	82·50 ,,	94·10 ,,	95·20 ,,
Magnesia ...	·64 ,,	·40 ,,	1·16 ,,
Potassium oxide ...	·06 ,,	·07 ,,	·06 ,,
Sodium oxide ...	·14 ,,	·22 ,,	·10 ,,
Sulphuric anhydride ...	·16 ,,	Nil.	Nil.
Phosphoric anhydride	Nil.	Nil.	Nil.

"A" contains much more calcium carbonate than is desirable for a soil. It is deficient in potash and entirely free from phosphates.

"B" and "C" are lime stones of fair quality, these stones are also free from phosphates and contain only a small amount of potash.

JOSEPH DE VERTEUIL,
Asst. Govt. Analyst.

SAMPLE NO 5 STONES COATED WITH LIME (FROM A RAVINE).

This sample consisted of a calcareous deposit, which on being broken was found to envelop a very hard stone of reddish brown colour.

The following are the results of analysis :—

	"*A*" *Outer Covering.*	"*B*" *Stone.*
Insoluble silica & silicates...	8·07 per cent.	88·48 per cent.
Oxides of iron & alumina ...	3·04 " "	7·56 " "
Calcium carbonate	...86·40 " "	1·96 " "
Magnesia ...	... ·30 " "	·24 " "
Potassium oxide	... ·11 " "	·05 " "
Sodium oxide ...	... ·04 " "	·13 " "
Sulphuric anhydride	Trace.	Trace.
Phosphoric anhydride	Trace.	Trace.

JOSEPH DE VERTEUIL,
Assistant Government Analyst.

Increase in Nitrates in Limed as Compared with Unlimed Soils.

THE analysis of the soils from Tobago has given one very interesting result. In one soil the percentage of nitrogen is very much greater than in the others. This was pointed out to the proprietor who informed me that two of the samples were taken within ten yards of each other and that the only difference was that one had been limed some time previous and the other had not. The influence of lime upon nitrification is well known but it is seldom that analytical results so striking have been published

In order to ascertain whether these results would be confirmed two samples of soils were taken from River Estate, one of which had been lightly limed recently and the other had not been limed. These results are shown in the following analysis :—

SAMPLES OF SOIL.

The samples contain :—

	"*A*" (*limed*).	"*B*" (*no lime*).
Total Nitrogen ...	0·122 %	... 0·118 %
Nitrogen as nitrates ...	0·0022 %	... 0·0011 %

A. Taken from a plot to which lime had been applied on the 15th September, 1909.

B. Taken from a plot unlimed.

JOSEPH DE VERTEUIL,
Asst. Government Analyst.

Government Laboratory,
2nd November, 1909.

SAMPLE OF SOIL TREATED WITH LIME.

Two small plots next to one another were marked off on the 22nd December, 1909

On plot A, no lime was added.

On plot B, lime was added at the rate of half a ton per acre.

The following results were obtained :—

		"*A*" (*no lime*).		"*B*" (*limed*).
7th Jan., 1910	...Nitrogen as nitrates	—·00173%	...	·00328%
1st Feb.,	„ ... „ „	—·00112%	...	·00154%
30th July,	„ ... „ „	—·00052%	...	·00199%

JOSEPH DE VERTEUIL,
Asst. Government Analyst.

Government Laboratory,
28th July, 1910.

SAMPLE OF FOSSIL SHELLS, "SPRING VALE" ESTATE, COUVA.

The sample contains :—

Water	6·12
Insoluble Silica and Silicates	18·80
Oxides of iron and alumina	14·74
Lime	15·23
Magnesia	·98
Potassium oxide	·06
Sodium oxide	·21
Phosphoric anhydride	·53
Sulphuric anhydride	·05
Carbon dioxide	27·23
Undetermined and loss	16·05
	100·00

JOSEPH DE VERTEUIL,
Asst. Govt. Analyst.

Government Laboratory,
26th July, 1910.

Section X.—MANURES.

Market (British) Prices of Manures (in Bags).

					£	s.	d.	
Nitrate of Soda	...	95	per cent.	...	£ 9	10	0	per ton.
Kainit	...	12	„	...	2	7	6	„
Bone Meal	...	—		...	4	0	0	„
Bone Ash	...	68–70	„	...	3	18	0	„
Basic Slag	...	26–30	„	...	1	15	0	„
„	...	35–39	„	...	2	2	0	„
„	...	42	„	...	2	7	6	„
Superphosphate Bone	Sol.	16	„	...	4	17	6	„
	Insol.	18	„	...		—		
	N'trgn.	$2\frac{3}{4}$	„	...		—		
Potash Sulphate (or Muriate)	...	80	„	...	9	5	0	„
Ammonium Sulphate		25	„	...	£ 12	0	0	„

Section XI.—ENTOMOLOGICAL.

List of Trinidad Microlepidoptera, with Descriptions of New Forms.

AUGUST BUSCK.

U.S. National Museum, Washington, D.C., U.S.A.

Up to the present time only seven (7) species of Microlepidoptera have been recorded in print from Trinidad, namely by Lord Walsingham in his "Revision of West Indian Microlepidoptera" (Proc. Zool. Soc. London, pp. 53–183, 1897).

In the following list such records have been added as could be made from the material in U.S. National Museum, collected by Wm. Schaus, P. L. Guppy, F. W. Urich and the writer.

In all this only comprises 25 species in 21 genera and of 6 families, a quite unsatisfactory record from the island, which undoubtedly supports many times more species.

It is hoped that this list and the assurance that future collections can be promptly determined, may stimulate the local interest in this group of exquisite insects, which should appeal to any one with eyes open for the wonders of nature. Amateurs or even boys or girls, who do not make a practice of collecting insects, may do valuable work in this group and help to make the fauna of Trinidad known to science. *Any* small moth, carefully caught as it comes to light in the evening is sure to be of interest and is pretty apt to prove new to science or at least a new record for the island.

The writer shall be glad to name any material sent to him.

The safest way to send these delicate insects is in papers, each specimen in an individual small triangular envelope, made of not too smooth paper, folded so as to make a flat safe enclosure. In this way many specimens can be packed rather tightly in a small box, strong enough to go through the mail.

The moths may also be sent pinned in a cork lined box, loosely packed in another larger box, but the other way is normally the safest and most satisfactory. When received, the moths can be relaxed, pinned, and spread, and make perfect museum specimens.

My friend, Mr. F. W. Urich, Entomologist, Board of Agriculture, Port-of-Spain, Trinidad, will be glad to furnish any other suggestion, which may be needed as to the various ways in which best to secure the moths. Specimens may be sent to him or directly to the writer.

The following is a list of the Microlepidoptere now known from Trinidad:

GELECHIIDÆ.

1. *Aristotelia rubidella*, Clemens.
2. *Epithectis (Aristotelia) eromene*, Walsingham.
3. *Lipatia crotalariella*, Busck, n. gen,; n. sp.
4. *Anacampsis episema*, Walsingham.
5. *Gelechia bosquella*, Chambers.
6. *Dichomeris (Ypsolophus) stratella*, Walsingham.

GELECHIIDÆ.—*Continued.*

7. *Dichomeris (Ypsolophus) indigna*, Walsingham.
8. *Glyphidocera caribbea*, Busck n. sp.

STENOMIDÆ.

9. *Stenoma (Antaeotriche) griseana*, Fabricius.
10. *Stenoma (Antaeotriche) tibialis*, Zeller.
11. *Stenoma (Anadasmus) immunda*, Zeller.
12. *Stenoma albana*, Fabricius.
13. *Gonioterma isabella*, F. & R.

SESIIDÆ.

14. *Sesia theobromae*, Busck, n. sp.

PLUTELLIDÆ.

15. *Heliodines urichi*, Busck, n. sp.
16. *Atteva punctella*, Cramer.

HEMEROPHILIDÆ.

17. *Glyphipteryx (Ussara) repandana*, Walker. (n. syn. *paradisea*, Walsingham.)
18. *Brenthia pavonacella*, Clemens.
19. *Hemerophila albertiana*, Cramer.

TINEIDÆ.

20. *Leucophasma carmodiella*, Busck.
21. *Opostega trinidadensis*, Busck, n. sp.
22. *Tineola uterella*, Walsingham.
23. *Ereunetis minuscula*, Walsingham.
24. *Setomorpha rutella*, Zeller.
25. *Tiquadra lentiginosa*, Zeller.

Sesia theobromæ—NEW SPECIES.

Male.—Labial palpi bright yellow. Antennæ black with ochreous underside. Face silvery, with a bluish black and yellow triangle from vertex. Head bluish black. Collar yellow. Thorax bluish black with three narrow longitudinal yellow lines and with a posterior fringe of yellow hairs. Forewings transparent, iridescent with deep violaceous black veins and costæ edge and with a rather broad dark brown terminal edge; Cilia blackish brown. Hindwings transparent with veins thinly indicated; Cilia blackish brown. Abdomen black, each segment with a transverse yellow band, all of which are narrow except the middle one, which is twice as broad as the others. Anal tuft large, flattened, paddle-shaped, black with a few lateral yellow scales. Underside of body yellow. Legs bluish-black on the exterior surfaces, yellow towards the body.

Alar expanse: 20 mm.

Food plant: *Theobroma cacao.*

Habitat: Trinidad, British West Indies.

Type, male, U. S. Nat. Mus. No. 13381.

Bred by Mr. P. L. Guppy from dry pods of Cacao.

A clear-cut typical *Sesia*, Fabricius, Busck, (*Ageria*, Walsingham *Trochilium*, Meyrick)* with the characteristic venation, palpi and posterior tibiæ of the genus.

It is specifically nearest *Sesia (Aegeria) deipyla* Druce in size and ornamentation, but differs in details of coloration, such as the

* See Busck, Proc. Washington Entom. Soc. XI, p. 118, 1909.

longitudinally striped thorax, the broad yellow band on the middle abdominal segment and the bluish-black legs.

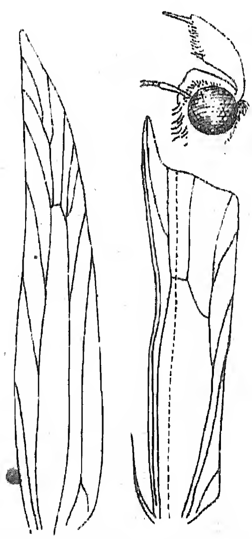
Lipatia, New Genus, (*Gelechiidæ*.)

Type: *crotalariella*, Busck.—[See Figure.]

Antennæ simple. Tongue stout. Second joint of labial palpi long, reaching vertex, somewhat compressed and thickened above, like certain *Trichotaphe* species, with smoothly appressed scales, which form a triangular upper tuft with projecting scales only on the upper side. Terminal joint short, rather thick, pointed. Fore-wings very long and narrow; 5–6 times as long as broad; costa nearly straight, slightly depressed on outer half; apex pointed; termen very oblique; the wing of greatest width at basal fourth, thence gradually narrower to apex. 12 veins; 7 and 8 stalked to costa; 6 out of the stalk to termen; 9 approximate to the stalk; 3 and 4 connate; 2 distant, emitted opposite to vein 10; 1 *b* furcate at base. Hind wing somewhat broader than the fore wings, trape-roidal; apex produced, termen strongly emarginate beneath apex; 8 veins; 6 and 7 long stalked; 5 nearest 6; the discal vein describes a long curve inward to the stalked veins 3 and 4; 2 distant.

Posterior tibiæ hairy above.

Related to *Aproaerema*, Durrant from which it differs in palpi, in the connate veins 3 and 4 of the forewing and in the stalked veins 3 and 4 of the hindwings.



Neuration and Head of

LIPATIA CROTALARIELLA (Busck)

Lipatia crotalariella, NEW SPECIES.

Labial palpi light brown with second joint blackish exteriorly. Antennæ light brown, annulated with white. Face, head, and thorax light brown. Forewings light ochreous brown, with a deeper tinge outwardly and with costal edge becoming broadly dark brown toward apex. On the middle of the wing, on the middle of the fold and at tornus are small aggregations of blackish scales, ill defined and easily rubbed off. Hindwings blackish fuscous. Abdomen dark fuscous with the basal joints velvety ochreous above. Legs ochreous, sprinkled with black exteriorly; tarsi blackish with narrow ochreous annulations.

Alar expanse: 13–14 mm.

Habitat: Trinidad, British West Indies, F. W. Urich, coll.

Food plant: *Crotalaria.*

Type, U.S Nat. Mus., No. 13382.

Cotype in British Museum.

Bred by Mr. Urich from the pods of Crotalaria. There has been for many years a specimen of this species in U.S National Museum bred by Dr. H. G. Dyar from pods of "woman's tongue," Accacia? sp. at Nassau, Providence Island, British West Indies, in 1891, which indicates a quite extensive range of the species.

Glyphidocera carribea, NEW SPECIES.

Antennæ dark brown, annulated with black; the deeply notched second joint in the male ochreous externally. Labial palpi ochreous, thickly suffused with dark brown and black; both joints with apex unmottled ochreous. Lower face ochreous. Head and thorax dark drown. Forewings dark ochreous brown, evenly and thickly sprinkled with black atoms; a very faint blackish dot on the middle of the fold and an equally faint larger spot at the end of the celli; terminal edge blackish; cilia ochreous brown. Hindwings light fuscous. Abdomen dark fuscous, lighter basally; base of genitalia purplish. Legs ochreous, suffused with blackish brown externally; tip of each joint ochreous. Alar expanse typical.

Habitat: Trinidad, British West Indies, A. Busck, coll.

Type U.S. Nat. Mus. No. 13383.

Close to the type of the genus, *G. audax*, Walsingham, but a smaller and darker form.

Heliodines urichi, NEW SPECIES.

Antennæ dull blackish brown. Face and head steely bluish black. Tongue and labial palpi ochreous. Thorax steely bluish black. Forewing shiny golden yellow, with dark metallic markings; extreme base steely black; four equidistant metallic violet costal spots, narrowly edged with black; opposite the interval of these three similar dorsal spots, like those on the costa formed of slightly raised scales. Extreme apical edge black with a bluish metallic, longitudinal streak from apex inwards, dividing the yellow part into two fingers. Cilia black. Hindwings black. Abdomen silvery. Legs black with silvery annulations at the joints.

Alar expanse: 9 mm.

Habitat: St. Clair, Trinidad, British West Indies, F. W. Urich, coll.

'On flowers of black sage" (*Cordia cylindrostachya*)."

Type U. S. Nat. Mus. No. 13384.

A very distinct pretty species, which I take pleasure in associating with the name of my friend F. W. Urich, to whom I am under many obligations professionally and socially.

The species is nearest *H. sexpunctella* Walsingham, but lacks the black costal edge and the black dorsal base of this species.

Opostega trinidadensis, NEW SPECIES.

Antennæ light golden with large silvery white eyecaps. Palpi white. Tuft on head and thorax silvery white. Forewings silvery white, immaculate until just before apex, where there is a very slight yellowish, black-edged, costal streak; at extreme apex is a conspicuous coal-black dot, equally visible on both sides of the wing; in the otherwise white cilia is a faint black costal streak and an even fainter short dorsal black line. Under side of the wing, except for the naked basal patch, light brown, with the black apical dot. Hindwings silvery gray, with darker gray cilia. Abdomen ochreous brown. Under side of body golden. Legs white; posterior tibiæ with stiff erect spines, which are continued out on the first tarsal joint.

Alar expanse: 8–9 mm.

Habitat: Trinidad, British West Indies; Urich and Busck, coll.

Type: United States National Museum, No. 13385.

Nearest and very similar to the North American *Opostega albogalleriella* Clemens, but a rather stouter and broader-winged species.

Section XII.—LIVE STOCK AND POULTRY.

Analysis of Cattle Foods. (Government Farm).

	Laby. No. 606. Molassine.	*Laby. No. 607. Stock Feed.*
Water	23·54	11·96
Fat	0·87	4·38
Albuminoids	6·31	9·62
Woody Fibre	4·35	10·93
Ash	6·82	3·58
Carbohydrates, &c.	58·11*	59·58
	100·00	100·00
Nutrient Ratio	1 to 9.5	1 to 7·3

*Containing:—
Sucrose ... 26·22 per cent.
Glucose ... 5·94 „ „

JOSEPH DE VERTEUIL.

Frozen Meat: Venezuela.

IT is announced that the Royal Mail Steamers will call at Puerto Cabello in future for cargoes of frozen meat for England. About 2,000 carcases will be shipped monthly, also hides, hoofs and horns.

A London firm purchased for $25,000 the buildings formerly used as brewery, enlarged them, and installed suitable machinery for the frozen beef trade.

Section XIII.—AGRICULTURAL EDUCATION.

(Extract)—Agricultural Education in France.

THE French have long anticipated us in realising the necessity for education in the most important national industry, agriculture. Thus the foundation of national agricultural schools in France dates as far back as 1848, and they have steadily progressed since that date for sixty years, rendering important advantages, although not thoroughly developed until after the great Franco-Prussian war of 1870–1, so that to the third Republic is due the honour of having definitely settled the important matter of both agricultural and horticultural technical education. For horticulture the law of 1873 ordered the creation of a national school of horticulture in the old kitchen garden of the palace at Versailles, and this has now become quite a real nursery garden of skilled horticulturalists and gardeners. Next the law of 1876 extended this technical instruction to the

country, organising farm schools for practical work, and these establishments have since turned out many generations of skilled agriculturists, and are still extending their usefulness. The organisation of these schools is still further regulated by the decree of January 19th, 1904. The law of August 9th, 1876, next authorised the establishment of a superior school of agriculture, which, since its foundation, has never ceased to supply a succession both of landowners and farmers possessed of the scientific knowledge so necessary for the most efficient exploitation of the soil, and also of officials for various agricultural services, surveyors, valuers, etc., and notably of teachers of agricultural subjects in schools, agents for the management of woods, waters, and studs, directors of agronomic stations, and agricultural engineers and analysts. Then in 1888 a dairy national school designed for the training of instructors for practical work, was opened. Yet another national school of agricultural industry was founded at Douai on March 20th, 1898, which, even in its third year, began to turn out men capable of superintending sugar factories and breweries, and all other industries connected with agriculture.—(*Agricultural Gazette.*)

Section XIV.—MISCELLANEOUS.

Rainfall Returns.

In Table I, an attempt has been made to present these returns in a form that is likely to be more useful to Planters. The rainfall is a very important factor in the growth of crops to which a great deal more attention has recently been paid, and numerous applications have been received at the Head Office for this information especially since the question of Rubber cultivation has been seriously taken up.

Table I gives the maximum and minimum returns over a period in many instances of 10 years, and in all cases the number of yearly records is shown on the table. The yearly average for 7 years and above gives fairly reliable data for each station.

The variation in the amount of rainfall at stations not far distant from each other is worthy of notice.

The necessity of accurately measuring the rainfall at the different stations cannot be too strongly impressed on those who have been kind enough to assist the Agricultural Department with this information.

The rainfall at Mayaro and Moruga appears to be exceptionally low.

Table II replaces the monthly returns formerly published in the *Royal Gazette.* In it are shown the returns for the last three months, the total from January to August 1910, and the total for the corresponding period in 1909.

TABLE I.—Maximum and Minimum Annual Rainfall at Stations in the Colony 1900-1909 inclusive.

STATIONS.	Max.	Min.	No. of years recorded.	Yearly Average.	Rainfall 1909 for comparison.
	Ins.	Ins.	Ins.	Ins.	Ins.
North West District.					
St. Clair, Royal Botanic Gardens ...	72	51	10	61	64
Port-of-Spain, Colonial Hospital ...	61	38	8	51	52
,, Royal Gaol ...	67	45	7	55	55
,, Constabulary Head Quarters	79	34	8	57	57
St. Ann's, Reservoir	88	57	10	73	81
Maraval, ,, ...	86	68	10	76	86
,, Constabulary Station ...	94	70	10	83	92
Diego Martin, ,, ,, ...	95	66	8	80	66
,, Waterworks... ...	86	67	7	78	70
,, River Estate ...	79	72	2	76	79
Fort George, Signal Station ...	74	57	9	67	69
North Post, ,, ,, ...	150	61	9	82	63
Carenage, Constabulary Station ...	81	59	10	68	68
Carrera Island, Convict Depot ...	65	42	10	51	57
Chacachacare, Light House ...	67	30	9	48	67
Santa Cruz—Maracas District.					
Santa Cruz, Constabulary Station ...	97	62	10	7	92
St. Joseph, ,, ,, ...	67	51	7	61	63
Maracas, Ortinola Estate	81	54	3	71	78
,, Government School ...	84	58	7	71	84
West Central District.					
Caroni, Frederick Estate	126	69	9	86	126
Chaguanas, Constabulary Station ...	83	53	10	67	83
,, Woodford Lodge Factory...	89	54	7	68	89
Carapichaima, Waterloo Estate ...	83	51	7	74	83
Couva, Exchange Estate	71	49	10	61	70
,, Milton ,, ...	72	62	3	67	74
,, Brechin Castle Estate ...	79	62	7	65	79
,, Perseverance ,, ...	68	55	6	63	68
,, Camden Estate ...	65	55	3	60	65
,, Constabulary Station ...	71	52	8	63	71
Savonetta, Esperanza Estate ...	71	48	9	55	71

TABLE I.—Maximum and Minimum Annual Rainfall at Stations in the Colony 1900-1909, inclusive.—*Continued.*

STATIONS.	Max.	Min.	No. of years recorded.	Yearly Average.	Rainfall 1909 for comparison.
	Ins.	Ins.	Ins.	Ins.	Ins.
San Fernando and Princes Town District.					
Claxton's Bay, Forres Park Estate ...	68	53	7	58	68
Pointe-à-Pierre, Concord „ ...	68	62	2	65	68
„ Plein Palais „ ...	81	60	4	69	69
„ Bonne Aventure Estate	72	62	3	67	72
Naparima, Usine St. Madeleine „ ...	72	57	9	66	69
„ Picton Estate	72	33	7	61	72
„ La Fortunée Estate ...	69	55	3	61	69
„ Lewisville	85	63	10	75	73
Princes Town, Constabulary Station ...	79	63	10	70	76
„ Cedar Hill Estate ...	74	70	2	72	74
Savana Grande, New Grant Estate ...	85	72	3	79	82
„ Malgretoute „ ...	74	63	2	69	63
„ Friendship and Ben Lomond Estate	63	55	4	60	60
Poole, El Rosario	117	98	9	102	104
Montserrat District.					
Montserrat, Constabulary Station ...	94	58	9	73	94
Brasso, La Vega Estate	100	72	2	86	100
Arima District.					
Arima, Torrecilla Estate	111	86	10	97	111
San Rafael, Constabulary Station ...	98	33	10	49	98
Guanapo, Talparo Estate	110	88	6	101	109

TABLE I.—Maximum and Minimum Annual Rainfall at Stations in the Colony 1900-1909, inclusive.—*Continued.*

STATIONS.	Max.	Min.	No. of years recorded.	Yearly Average.	Rainfall 1909 for comparison.
	Ins.	Ins.	Ins.	Ins.	Ins.
South West District.					
Oropuche, Pluck Estate	69	68	2	69	69
,, Constabulary Station ...	90	55	10	67	68
Siparia, ,, ,, ...	107	61	10	81	107
Cedros, ,, ,, ..	72	44	10	57	54
Cap-de-Ville ,, ,, ...	93	71	9	83	86
Guapo, Adventure Estate	81	56	8	69	66
Erin, La Ressource ,, ...	60	46	6	54	59
North Coast.					
Blanchisseuse, Constabulary Station ...	100	70	10	86	96·
Toco, Aragua House	110	83	10	93	94
East Coast.					
Mayaro, Constabulary Station ...	76	29	10	38	38
Manzanilla, ,, ,, ...	123	96	8	105	110
Matura, La Juanita Estate ...	121	114	2	117	121
Sangre Grande, Sta. Estella Estate ...	125	90	9	113	121
South Coast.					
Moruga, Constabulary Station ...	49·	26	8	32	34
Tobago.					
Tobago, Botanic Station	113	64	9	67	86
,, Hermitage Estate ...	116	86	2	101	116
,, King's Bay ,, ...	97	79	2	88	97
,, Riversdale ,, ...	77	64	2	70	77

TABLE II.—Rainfall Returns, 1910.

Names of Stations.	June 1910.	July 1910.	August 1910.	Totals January to August 1910.	Totals January to August 1909.
	Inches.	Inches.	Inches.	Inches.	Inches.
North-west District.					
St. Clair, Royal Botanic Gardens ...	6·34	6·40	13·89	40·32	40·24
Port-of-Spain, Colonial Hospital ...	5·24	5·07	13·39	33·26	31·33
Port-of-Spain, Royal Gaol..	5·69	7·25	14·15	39·00	33·76
Port-of-Spain, Constabulary Station, Head-quarters ...	6·04	6·54	13·70	38·88	34·78
St. Ann's, Reservoir ...	8·88	6·61	13·99	44·72	48·91
„ Coblentz Avenue	6·56	6·75	13·29	37·98	42·42
Maraval, Reservoir ...	8·31	7·70	15·52	54·41	47·70
„ Constabulary Station ...	8·75	8·99	11·54	54·51	52·30
Diego Martin, Constabulary Station ...	8·33	7·91	10·50	50·78	25·47
Diego Martin, Waterworks	8·80	8·19	10·90	50·51	42·92
„ *River* Estate	8·96	8·29	10·72	51·50	47·43
Fort George, Signal Station	7·19	6·40	12·50	42·41	41·41
North Post, „ ...	8·12	6·51	11·36	47·10	36·00
Carenage, Constabulary Station ...	11·32	8·20	11·52	44·97	48·30
Carrera Island, Convict Depot ...	6·22	4·92	11·48	35·59	36·18
Chacachacare, Light house	5·63	3·64	7·03	40·28	37·68
Santa Cruz—Maracas District.					
Santa Cruz, Constabulary Station ...	8·13	4·52	14·44	55·99	53·99
St. Joseph, Constabulary Station ...	7·82	6·76	9·90	36·82	36·11
Maracas, *Ortinola* Estate..	7·23	6·91	11·36	52·15	43·16
„ Government School ...	7·93	6·59	9·15	52·93	43·73
West Central District.					
Caroni, Frederick Estate...	15·38	13·40	20·74	87·18	75·49
Chaguanas, Constabulary Station	8·40	6·47	12·94	48·76	47·45
Chaguanas, Woodford Lodge Factory ...	7·09	6·95	13·00	45·88	50·92

TABLE II.—Rainfall Returns, 1910.—*Continued.*

Names of Stations.	June 1910.	July 1910.	August 1910.	Totals January to August 1910.	Totals January to August 1909.
	Inches.	Inches.	Inches.	Inches.	Inches.
West Central District.—Continued.					
Carapichaima, Waterloo Estate	8·55	9·04	13·26	50·74	48·47
Couva, Exchange Estate...	4·82	5·51	9·46	37·36	39·50
„ Brechin Castle Est.	6·14	7·52	12·13	45·89	44·77
„ Perseverance „	4·92	6·68	14·88	44·75	39·52
„ Camden „	3·84	4·69	8·07	32·06	36·90
„ Milton „	6·50	7·61	10·95	44·79	44·36
Savonetta, Esperanza „	6·02	7·37	11·09	41·86	36·36
San Fernando & Princes Town District.					
Claxton's Bay, Forres Park Estate	5·27	6·90	8·52	37·41	37·23
Pointe-à-Pierre, Bonne Aventure Estate ...	10·59	6·12	8·41	44·31	38·38
Naparima, Picton Estate..	9·00	7·06	8·79	42·08	41·39
„ Usine St. Madeleine Estate...	9·14	12·04	10·86	54·13	40·02
„ La Fortunée „	10·88	7·50	8·57	45·48	40·43
„ Craignish „	8·05	10·30	13·46	49·77	48·33
„ Lewisville „	10·43	10·51	13·49	57·32	40·49
Princes Town, Cedar Hill Estate	11·42	10·07	12·99	57·03	44·01
Princes Town, Constabulary Station ...	10·11	8·93	12·80	56·09	43·85
Savana Grande, New Grant Estate ...	12·42	10·02	13·05	60·66	47·03
Savana Grande, Malgretoute Estate ...	8·83	6·44	13·81	49·93	37·29
Savana Grande, Friendship & Ben Lomond Est.	7·80	9·05	12·90	48·00	32·18
Poole, El Rosario ...	15·37	12·10	14·12	77·19	58·88
Montserrat District.					
Montserrat, Constabulary Station	8·10	10·92	12·87	55·70	53·84
Brasso, La Vega Estate ...	10·41	7·99	15·16	61·60	56·79

TABLE II.—Rainfall Returns, 1910—CONTINUED.

NAMES OF STATIONS.	June, 1910.	July, 1910.	August, 1910.	Totals January to August 1910.	Totals January to August 1909.
	Inches.	Inches.	Inches.	Inches.	Inches.
Arima District.					
Arima, Torrecilla estate ...	14·64	8·81	11·88	58·72	67·13
San Rafael, Constabulary Station	18·26	15·83	15·33	78·00	57·82
Guanapo, Talparo estate...	14·64	10·53	16·83	79·50	62·00
South-west District.					
Oropuche, Pluck estate ...	11·86	8·10	11·87	47·32	43·42
,, Const'blry Station	10·21	7·50	10·02	46·16	42·53
Siparia, ,, ,, ...	12·83	10·40	15·66	66·53	68·71
Cedros, ,, ,, ...	9·97	6·13	11·52	54·42	34·19
Cap-de-Ville, Constabulary Station	19·61	8·06	13·23	68 56	60·65
Guapo, Adventure estate..	10·94	6·12	9·66	46·43	40·38
Erin, La Resource estate...	10·92	6·39	15·00	51·62	33·34
North Coast.					
Blanchisseuse, Constabulary Station ...	16·99	9·12	11·52	91·08	58·58
East Coast.					
Mayaro, Constabulary Station	4·19	2·79	3·24	22·94	20·98
Matura, La Juanita estate	11·84	9·75	11·07	75·23	74·13
Sangre Grande, Sta. Estella estate	5·92	10·40	14·37	87·71	69·83
South Coast.					
Moruga, Const'blry Station	4·86	2·31	3·26	19·69	21·50
Tobago.					
Tobago, Botanic Station...	9·16	8·80	6·00	39·55	52·10
,, Hermitage estate..	10·56	8·52	8·73	63·46	70·50
,, Riversdale estate..	7·84	4·66	8·27	44·14	46·72
,, King's Bay ...	9.39	4·90	7·40	50·32	60·19

Rainfall for September, 1910.

Districts.	Maximum.	Minimum.	Average.
	Inches.	Inches.	Inches.
North-west District ...	13·04	5·45	8·35
Santa Cruz-Maracas District ...	8·02	6·12	7·18
West Central District ...	10·77	5·31	7·73
San Fernando and Princes Town District	9·60	3·10	6·03
Montserrat District ...	6·18	5·12	5·65
Arima District	8·21	4·73	6·43
South-west District ...	12·89	2·69	7·01
North Coast	6·74	3·53	5·63
East Coast	10·51	2·97	7·43
South Coast (Moruga) ...	1·77	...	...
Tobago	10·54	10·09	10·32

Rainfall for October, 1910.

Districts.	Maximum.	Minimum.	Average.
	Inches.	Inches.	Inches.
North-west District ...	12·76	5·83	8·03
Santa Cruz-Maracas District ...	14·31	8·06	11·92
West Central District ...	15·75	6·93	8·93
San Fernando and Princes Town District.	12·13	4·65	8·39
Montserrat District ...	10·97	9·06	10·01
Arima District	16·16	10·79	13·18
South-west District ...	12·82	6·04	9·24
North Coast	16·14	9·80	13·52
East Coast	20·14	3·31	14·59
South Coast (Moruga) ...	3·07	...	...
Tobago	15·03	9·22	12·12

Useful Agricultural Statistics.

A.—General.

1. The total area of the Colony is 1,195,500 acres.

2. The estimated area of cultivable land is :—

(*a.*) In private hands .. .. 573,200 acres.

(*b.*) In that of the Crown ... ... 302,300 „

3. The estimated area now beneficially occupied by cultivation is 379,651 acres, or 43·37 per cent. of cultivable area.

4. The principal cultural industries in order of importance are :—

Cacao	245,706 acres.
Sugar	65,600 „
Ground Provisions	32,938 „
Coconuts	17,520 „
Rice	9,522 „
Coffee	4,120 „
Rubber	2,960 „
Fruit	885 „
Other	400 „

5. The following export duties are imposed upon produce grown in the Colony :—

(*a.*) For General Revenue purposes, none.

(*b.*) For special purposes :—

	Immigration.	Agricultural Tax.
Cocoa ...	4d. per 100 lbs.	1d. per 100 lbs.
Sugar ...	2/7½ „ 1,000 „	1½d. „ 1,000 „
Molasses ...	2/4 „ 100 gallons.	
Rum and Bitters	7/- „ 100 „	
Coconuts ...	6d. „ 1,000 nuts.	3d. per 1,000 nuts.
Copra ..	2/- „ 1,000 lbs.	8d. (per ton.)
Coffee ...	4d. „ 100 „	

6. The last census taken in 1901 gave a total population of 255,148. The population is now estimated at about 350 000.

(*a.*) The portion of population directly employed in the sugar industry is estimated at 65,000 or 18·57 per cent.

(*b.*) The portion of population directly employed in all other industries is estimated at 65,000 or 18·57 per cent.

7. Approximate estimate of capital invested in properties now existing : —

(*a.*) Sugar industries ... ... £1,500,000.

(*b.*) Other industries ... ... £8,000,000.

B.—Sugar Industry.

8. The area under cultivation in sugar is estimated at 65,600 acres, equal to 7·49 per cent. of the cultivable area, and 17·28 per cent. of all lands under crops in the Colony.

9. The total production of sugar for each year since 1895 is estimated as follows :—

1895–6	...	...	...	69,595 tons.
1896–7	...	...	..	59,678 ,,
1897–8	...	...	...	54,933 ,,
1898–9	...	...	...	58,109 ,,
1899–1900	..	...	..	58,837 ,,
1900–1	...	.	...	46,277 ,,
1901–2	...	...	...	60,880 ,,
1902–3	..	...	..	57,830 ,,
1903–4	...	...	...	47,778 ,,
1904–5	...	...	...	50,744 ,,
1905–6	...	...	...	48,219 ,,
1906–7	...	...	...	50,500 ,,
1907–8	...	...	.	50,564 ,,
1908–9	..	...	...	49,933 ,,

There is no data to arrive at individual qualities for the period in question. The present output is about 300 tons of Muscovado or Raw sugar, the balance being yellow or dark crystals in varying proportion to suit market requirements.

Other Industries than Sugar.

10. The total area under cultivation of industries other than sugar, rum, and molasses, showing an annual export of £500 and upwards is estimated as follows :—

Cocoa	—245,706	acres	equal	to	64·72	per cent.	of all	crop lands.
Coconuts—	17,520	,,	,,	,,	4·62	,,	,,	,,
Rubber —	2,960	,,	,,	,,	·78	,,	,,	,,
Fruit —	885	,,	,,	,,	·23	,,	,,	,,

CONTENTS.

Obituary Notice.

Mr. J. H. Hart, F.L.S., &c., &c.

Died 20th February, 1911.

To-day, Trinidad has lost at the age of 64 years its most prominent all-round agriculturist and botanist, and the tropical world one of its most useful and energetic Naturalists. It was fitting that Miss Pauline McLean, the Herbarium Assistant was at his bedside during the last moments of his life, which occurred at his late residence, Coblentz Avenue, St. Ann's, Trinidad, death coming shortly after midday, for she had been connected officially with him from the first year of Mr. Hart's Official appointment, as Superintendent of the old Royal Botanic Gardens, and it was they who had the sorting out together and arranging of the invaluable collections of Trinidad plant-specimens, which had been bundled up and left behind by Prestoe, Crueger and others. It was to his intuition, enthusiasm, knowledge and hard work that the Department of Agriculture possesses the magnificent herbarium deposited at the Experiment Station, St. Clair at the present moment. His work alone in this direction would have stamped him for ever a credit to himself and to his Government. But to see and know what he did for agriculture and economic botany, we would refer the reader to the fine series of bulletins and annual reports that were so promptly and regularly presented by this prolific writer. His was a life truly well spent for his fellow citizens!

Mr. Hart came to Trinidad from Jamaica in 1887, when he was 40 years old. He retired from the public service 21 years later (1908).

In Jamaica he was engaged in the botanical department of that island for many years where his name has since been commemorated by a number of plants that he first found and brought to light, as well as with that of the cinchona industry. There it was that the late G. S. Jenman and he were together. Recently (1909) it fell to Mr. Hart to edit and publish this great *fern* authority's work entitled "Ferns and Fern Allies," embodying as it does, many Trinidad forms, among which will always keep the memory of Mr. Hart fresh in mind is the fern:—

Pteris Hartiana.—"A very striking species among several "that are remarkably fine, and of "conspicuous individuality."

It was Mr. Hart who during a special visit to Nicaragua in 1893 introduced at that time into Trinidad, the *Alligator Cacao* (*Theobroma pentagona*), the *Nicaraguan shade tree* (*Gliricidia maculata*) and other plants of use to man.

From all parts of the tropical world came continuously seeds and plants of value to the island—East Indian grafted mangos, oranges, the spineless lime, timbers, rubbers, coffees, vegetables and hosts of others. The æsthetic side was not forgotten for we find ornamental plants of number and kind, far too many to enumerate in the present short notice which found their way to prominence through his instrumentality.

Leaving for a moment the plant side let it be recorded that the fauna of this island claimed his close thought and research. Therein, also, has the name of J. H. Hart been enshrined and perpetuated. Do what the future historian may, when the time comes to collaborate the work of the botany and flora of the West Indies, his name will be found in the front rank of investigators and workers. Returning to plant studies, it may be added, his later years were largely occupied in the examination of, and the combatting of, the many fungal diseases of economic plants, such for instance as the "Canker" of the cacao tree.

Whatever he undertook was thorough throughout. His early training in England in the propagation of tropical plants was of an exceptionally high order. It was he who obtained three cuttings to root (a most difficult feat) out of *three inserted* of the rare, brick-red Bougainvillea (*B. lateritia*,) one of which is to be seen in the Grenada Botanic Station, where years ago it had ascended and overgrown the upper branches of a large tree.

Before coming to the West Indies Mr. Hart had been connected with horticultural operations in Nova Scotia.

Much could be written down to multifarious engagements and occupations that claimed the attention and time of this untiring gentleman, but let it suffice to say that the new edition of his work on cacao, which is about to be issued, will form an appropriate closing to a life of example, energy, and usefulness for those of us who are still left behind in the field of labour so nobly trodden by this incessant worker.

W. E. BROADWAY.

February 20th, 1911.

Section I.—SUGAR.

Results obtained in the study of the Froghopper during the Wet Season of 1910,

By

Lewis H. Gough, Ph. D.

THE following paper has been compiled to give a general review of the present state of knowledge of the life-history of the froghopper, (chiefly of the known data obtained during the wet season), the effects on the canes, and the methods of controlling the insect hitherto used or recently recommended.

The paper will be found to consist of four parts, a review of the already rather extensive bibliography, showing the gradual advancement of knowledge which is rendered doubly interesting when one sees how correct observations have been made and theories advanced, only to be contradicted by some other observer; this is largely due to the fact that practically all the work has hitherto been done by amateurs or by non-biologists. The symptoms and the cause of the blight and the effect of the ravages of the froghopper are discussed, then follows the life-history of the insect as ascertained by myself during the wet season of 1910. The remedies recommended by earlier authors are discussed fully in the fourth part, where my own recommendations will also be found; here I have endeavoured to give, where possible, estimates of cost.

I take this opportunity of thanking His Excellency Sir George Le Hunte, K.C.M.G., for the interest he has taken in my work, the Trinidad Agricultural Department, the Board of Agriculture and the Agricultural Society of Trinidad and Tobago for putting their resources at my disposal. To the New Colonial Co., the Trinidad Estates Co., Sir E. Tennant's Estates Co., Messrs. Alston & Co., Kleinworth and Gordon Grant, for the facilities of working on their estates, to the Trinidad Estates Co., especially for their hospitality during the six months I was residing on their estates.

I am personally much indebted to Prof. Carmody, Messrs. Kay, Murray, Arbuckle, Gilbert, Bolton, F. W. Urich, P. L. Guppy, and to Dr. Urich and Dr. Fredholm for help, material and advice, and to Messrs. Arnott Lambie & Co. for estimates of wholesale prices.

Synopsis.

A.—History of the Froghopper Blight in Trinidad, compiled from published records.

(1.) Discussion of the literature.

(2.) Summary of the literature.

B.—The symptoms and results of the Blight.

(1.) Alterations in the Canes.

(2.) Presence of Froghoppers.

(3.) Cause of the blight by the nymphs.

(4.) Extent and nature of the damage.

C.—Life-history of the Froghopper.

(1.) The eggs.

(2.) The five larval stages.

(*a.*) Morphology of the different stages.

(*b.*) Biology of the nymphs.

(3.) The adults.

(*a.*) Morphology.

(*b.*) Biology.

1. Proportion of sexes.
2. Habits and tropisms.
3. Enemies and diseases.

(4.) Geographical Distribution of the species.

D.—Methods of Prevention of the Damage caused by the Froghopper.

Discussion of the Literature.

The date of the first appearance of the Froghopper Blight of the Sugar Cane in Trinidad is obscure possibiy for the reason that for a long time the cause of the blight was unsuspected. It is also probable that it was for some time confused with other diseases and the earliest accounts of "blight" may or may not have referred to froghopper blight. Blight was mentioned by E. E. H. Francis in a paper read before the Scientific Association of Trinidad, on the 19th of February, 1879, republished in 1892 in the *Agricultural Record*, but there is no evidence to connect the disease with the froghopper. The same publication contains a reprint of a paper by Dr. Cruger, written in 1863, (*Agricultural Record*, 1892, p. 78), in which mention is made of a larva of a species of Delphax living on the roots of the sugar cane, which may or may not have belonged to the froghopper. Probably it did not, as no mention is made of the froth by which the larvæ are surrounded and no mention is made of any damage. Although this paper was written previously it was not published until two years after a paper by Hart had appeared, in which that author reports on the "Blight" in Chaguanas in November, 1889, and ascribes it to the attacks of a *Tomaspis*. He observes correctly that the roots punctured by the nymphs die off, causing the rest of the plant to suffer in proportion; as remedies he suggests quicklime, soot or woodashes, whilst the plant is growing, and burning the trash after the crop is taken off. At the

suggestion of Mr. McLachlan he further recommends spraying with paraffin emulsion. HART also appears to be the first to have observed the "Froghopper fungus" in Trinidad.

Between 1890 and 1906 nothing further seems to have been written, excepting perhaps in the daily press, and such articles being inaccessible will not be referred to here. In 1906 an unimportant article, unsigned, appeared in the *Agricultural News*, the title being "A New Sugar Cane Pest," though it could then no longer claim to be a "new" pest, having already been described by Hart 16 years previously.

In October, 1906 HART reprinted his former paper in the *Botanical Department Bulletin* and commented on it, now favouring the idea that fungus was at the bottom of the trouble.

A report by COLLENS was published in 1906 "on diseased canes at Harmony Hall and Tarouba Estates," and "Result of inspection of Cane Blight Disease at Brechin Castle Estate," this report was republished in 1909 by the Agricultural Society, and will be found commented on in connection with other papers in that collection.

In 1907 BARRETT records some observations on the Sugar Cane Blight. In consequence of letters from Messrs. Smith Robertson & Co., H. E. Murray and J. W. Sargeant reporting the occurrence of blight in the Sugar Canes in the Waterloo and Orange Grove Estates, read at a meeting of the Agricultural Society, on July 16th, 1907, Mr. Barrett was requested to visit the Estates in question and advise on the matter. BARRETT evidently did not consider the froghopper to be the chief agent in producing blight, but recommended the continued use of trap-lights as a method of extermination; he did not recommend spraying for the froghopper. BARRETT'S recommendations were mainly directed against fungoid diseases. In a later paper by BARRETT, "Cacao pests of Trinidad with Notes upon Miscellaneous Crops" the froghopper is again mentioned, and the statement is made that "trap-lights have been used with considerable success on Exchange Estate at Couva."

Some important papers on the froghopper appeared in December, 1908 in the *Proceedings of the Agricultural Society of Trinidad and Tobago*, by HERIOT, MCLEOD, FENWICK, CARACCIOLO, COLLENS, BLACK, ARBUCKLE, GAUL and GILBERT.

HERIOT describes some experiments made to demonstrate whether the froghopper is the cause of the trouble. An experiment in which he placed a number of nymphs on some canes grown in tubs gave negative results, the experimental canes not differing from the controls. The same experiment with Para grass showed blighting of the experimental plants, the controls remaining healthy. HERIOT was not able to obtain eggs.

MCLEOD seems to have observed the eggs, and describes them as yellowish white in colour, $\frac{1}{32}$ of an inch long, oval and tapering to a point at the ends. He states that they "are laid in small clusters of from 2 to 6 or more on the upper side of a cane leaf, old cane stool, or root to which they are attached by means of a viscid liquid." It will be shown later, that this mode of attachment is not the normal one, yet it is quite probable, that he was the first observer to see eggs of the insect, which are really of the size and appearance described. His description of the larvæ is rough, but recognisable, and his observations of their changing their position on the roots when feeding, and their ascent of the cane when about to emerge as adults are correct. However in stating that they prefer dead roots to living ones he has confused cause with effect. He correctly states that the larvæ cannot burrow, nor can it follow the roots into the ground except through cracks or holes already existing. An observation of an adult "voiding half a drachm of clear liquid in one hour" when feeding on "a young and juicy leaf" led him to the conclusion that the adults

were responsible for the main damage, a conclusion with which, as will be seen later, I cannot quite agree. He recommended burning the fields after the canes had been cut, and allowing fields that have suffered much to lie fallow for a year.

CARACCIOLO, in his letter, rightly ascribes the damage to the nymphs. His conclusion that the eggs are laid in the ground is incorrect. He recommended drenching the ground with rosin wash or lime and sulphur wash as a preventative and the burning of the trash.

COLLENS describes the damage done at Caroni, where the froghopper blight was then complicated by root fungus. He first suggests using the froghopper-fungus to destroy the insects; and in suggesting that the true cause of the "blight" is due to "the efforts of the cane to respond to and throw off these diseases by the formation of fresh roots . . . . . were rendered ineffective by the persistent attacks of . . . . . the nymphs on the young rootlets, the consequent injury and destruction of which prevented the plants from recovering quickly," he came near to the truth. He however advanced the theory that the froghopper cannot be regarded as primarily responsible for the outbreak of the present attack of Blight." We know now that the blight is due to the persistent attacks on the roots by nymphs of the froghopper, by which the distal portions of the rootlets are destroyed, the reserve materials of the cane being depleted in its endeavours to replace the damage. COLLENS recommends quicklime and the use of traplights, and advocates protection of wild birds.

BLACK records the first appearance of frog-hopper blight in the Waterloo group of estates as having appeared in 1906, and rightly comments on the froghopper being inseparable from the blight. He further states, that this form of blight was not known in the days when the Bourbon cane alone was cultivated.

ARBUCKLE comments on the same field being blighted one year and healthy in the next, and reports on spraying with Bordeaux Mixture and rosin wash on BARRETT's recommendation. The spraying yielded negative results. He advances reasons to show that the blight is independent of root-fungus.

GAUL records that where the blight was in evidence froghoppers were also present, and further records fields blighted one year yielding good returns next year.

GILBERT gives the history of the blight at Caroni in 1908. He finds ratoons suffer worse than plant canes, and reports that lime and sulphate of copper are of no use in checking the blight, and that extra draining and burning of the trash are of very little use.

In 1909 HART again took up the subject (Remarks on "Sugar Cane Blight, etc." *Journal Agricultural Society Trinidad*, Vol. IX, pp. 32—40, Society Paper No. 357.) In this paper HART rejects his conclusions of 1890, and suggests that fungus diseases had more to do with blight than the froghopper has. He reviews the papers by HERIOT, McLEOD, etc. A suggestion is made of utilising the froghopper fungus in exterminating the froghopper. As remedies for the froghopper, trap-lights and burning of trash are suggested.

In 1909 a series of papers appeared in the February number of the *Proceedings of the Agricultural Society of Trinidad*. Soil analyses are given by Professor CARMODY and Dr. URICH, and the life histories and other phenomena are discussed by CARMODY, COLLENS and URICH.

CARMODY in his report condenses the evidence of planters and deducts conclusions from it. He finds:—

"(1.) Froghoppers attack canes for five or six weeks at a time, and only during the wet months from July to September.

(2.) The most serious attacks have been confined to flat lands in the Caroni basin, and in the districts of Couva and Chaguanas.

(3.) In the same part of a field, and within the above months, Froghoppers may re-appear a second time. In 1908 they reappeared a third time at Couva.

(4.) During the remaining months of the year the canes are free from any large numbers of Froghoppers.

(5.) A fungus appears on each swarm of the developed insect and destroys large numbers of them. The immature insect has been experimentally infected and killed by this fungus.

(6.) Froghoppers have been found in fields of healthy canes without causing any visible injury, and in fact are found in all parts of the Colony.

(7.) Parts only of fields are attacked in many instances, and surrounding healthy canes are not attacked to any serious extent.

(8.) Wherever froghoppers are unusually abundant, the canes on closer examination have been found diseased from other causes, and the juice is abnormally acid.

(9.) The canes may recover.

(10.) If they do not, the same field may next year give a normal or increased yield, although no remedial measures have been tried.

(11.) Canes from badly diseased stools have reproduced healthy stools at the Laboratory.

(12.) In 1906 the froghopper spread over a very much wider area than in 1907 or 1908."

From these observations CARMODY draws the following conclusions :—

"(*a.*) That the cane in its natural state is not the favourite food of the froghopper.

(*b.*) That the injury done to canes, though serious for the time is temporary in character and does not extend beyond a few months in some cases, or a year in others.

(*c.*) That the dormant stage of the froghoppers is due either to :—

(i.) Death of large numbers from the fungus mentioned.

(ii.) Migration to other plants through the absence of suitable cane food, *i.e.* unhealthy canes.

(iii.) A period of aestivation.

(*d.*) Observation 7 indicates that particular canes only are attacked owing probably to some alteration in the substance in the cane, *e.g.* excessive acidity.

(*e.*) Observation 8 indicates that this alteration is due to pre-existing diseases, either of fungoid or insect origin, or both.

(*f.*) Observations 10 and 12 indicates that the spread of the froghopper is influenced in some way by climatic conditions and consequent soil conditions."

COLLENS (1909) reports on diseased canes at Harmony Hall and Tarouba estates, and gives the result of an inspection of cane blight disease at Brechin Castle estate. (Both papers will be discussed together here.)

After describing the development of the Disease, the Climatic Conditions, the Soil Conditions and the other insect attacks, COLLENS rightly ascribes the damage to the nymphs, which kill off the rootlets on which they are feeding, causing the destruction of the plants ; he considers the damage done by the adults to be of little consequence. He then describes

the diseased conditions of the canes, and mentions the presence of potash in the froth. At Brechin Castle, the blight was complicated by *Trichosphaeria*. As remedies he suggests thorough draining, capture of adult insects, application of lime wash to the roots, manuring with nitrate of soda, weeding, and heaping up the soil around the cane roots, burning all dead and dying canes, destruction of all destructive types of insects (no method indicated), spraying with kerosene emulsion to kill froghopper nymphs, and soaking all fresh cuttings (plants) in Bordeaux Mixture for 6 to 12 hours.

Urich discusses the systematic position of the froghopper, and appears to be the first to draw attention to the fact that it occurs also in the Cocoa plantations. He mentions the difficulty of applying the usual insecticides successfully. He recommends trap-lights to catch the adults, burning and ploughing infected fields, weeding and burning the weeds, firing abandoned sugar estates and encouraging insectivorous birds and lizards.

In April, 1910, Urich records the field work he had done during the past year. He had not been able to confirm McLeod's observations, that the eggs are laid on cane-leaves, cane or grass-roots, and suggests (erroneously) that the eggs are deposited singly on rootlets or on the ground. He records that the nymphs move from one rootlet, when it gets exhausted, to another, and states their preference for Boucans and for recently forked ground. The nymphs change their feeding places after moulting, and ascend the food plant for their last moult. He states that the nymphal period lasts about 30 days, and that the last stage is the longest. The adults rest in the axils of the leaves or in the folds of unrolling leaves. They are quiescent during the day, becoming active towards evening, when they feed or mate. Some also feed in the day-time. Coitus takes place during the day-time. They often crawl on the ground at night, and they are readily attracted to light. Urich only knew the eggs from dissection of the females, which he finds to contain 20 to 30 eggs; oviposition takes place continuously, and there are no well-developed broods. Nymphs and adults can be found at all times of the year, in the dry season especially near the drains. Where blight was observed froghoppers were always present, not so root-fungus. No natural enemies were observed. Mention is made of the "Froghopper fungus" but there is some doubt as to whether it is a parasitic fungus. Trap-lights are recommended as method of control, they are said to catch about $\frac{1}{3}$rd females $\frac{2}{3}$rds males (surely an error as will be shown later). Weeding and trashing combined with removal and destruction of the weeds or trash are recommended, (this correctly though not deduced from the then known facts). Spraying with knap-sack pumps is recommended with kerosene emulsion, kerosene-lysol emulsion and cyanide of potash solutions. He summarises his proposed remedies as follows:—

(1.) Keep fields and traces as free from grass as possible.

(2.) Avoid Boucans in fields affected or likely to be so.

(3.) Do all spraying early in the year.

(4.) Use trap-lights to locate insects and follow up by weeding fields and spraying cane stools.

There follows a seasonal History Record of Froghoppers on Cane Estates, a Return of Adult Froghoppers caught by trap-lights, Formulæ of insecticides and Bibliography (incomplete).

In August, 1910 Gough published a table of trap-light samples from all parts of the Colony, showing that the average catch of females was only about 1½ per cent. and not 30 per cent. as stated by Urich.

On September 20th, Gough read a paper at the Agricultural Society's meeting, demonstrating and describing the eggs, and showing that they are laid in the dry leaf-sheaths of cane or grass leaves, and describing

some of the habits of nymphs and adults. Males and females are both found to be attracted by trap-lights, but owing to the more sedentary habits of the females, trap-lights collect practically only males. Mention is made of experiments made with "Froghopper fungus," by which infection and death were produced on nymphs and adults. Spraying with an insecticide to kill the eggs is suggested, and it is suggested utilising the "fungus" by spreading the disease early in the season.

On September 23rd Urich, at a meeting of the Board of Agriculture confirms the finding of eggs, and in a report published the same date refers to the position where the eggs are laid. He however does not describe them in any way and from internal evidence had possibly not seen them at the time of going to print. He states that "eggs kept fairly dry remained dormant from February to June, when they hatched on being exposed to rain," yet in April, 1910 he had stated that the eggs are laid singly on rootlets or in the ground, and that he only knew the eggs from dissections. He nowhere records his first observation of an egg, all his published observations referring either to the date of stocking an observation cage with adults and the date of the first observation of a nymph, or to the date of removal of a grass or cane root from the field and the subsequent first appearance of nymphs. From these inconclusive data he deduces that the hatching period occupies from 12 to 20 days under favourable circumstances to four months under dry conditions. Twelve days is probably too short a period. He has observed four nymphal stages occupying 32–45 days in all. (There are really five stages). As methods of control clean weeding is recommended. Trap-lights are rejected without giving the reason. It is further recommended to plant cover crops on recently ploughed lands. Some experiments are described, and an incomplete bibliography is given.

Rorer published simultaneously a paper on the Froghopper fungus. A short description of the fungus is given, some experiments are described, and the possibilities of using the fungus to control the Froghopper are said to seem quite good.

Urich on the same date recommends trashing and burning in an article which originally appeared in the *Mirror* but was subsequently republished in the *Proceedings of the Agricultural Society*. It is strange if Urich had known the eggs of the froghopper at the time of writing his report for the Board, that he should then have recommended weeding only and not have thought of the possibilities of attacking the eggs themselves on the trash.

In November 1910 Gough describes some experiments with the Froghopper Fungus; he had succeeded in establishing the disease at Brechin Castle in a field where the fungus was not previously present. Two methods had been tried, dusting out spores and exposing cultures in the angles of cane leaves, the latter method giving very much more striking results than the former. It was also stated that experiments to inoculate mice and rats had failed.

Rorer, in the same number of the *Proceedings of the Agricultural Society* identifies the fungus, straightens out its synonymy, gives a description accompanied with illustrations, and describes a successful experiment of dusting out the spores. He suggests a new method of spreading the infection by capturing froghoppers by trap-lights, infecting and liberating them. This method will probably prove quite usable, if modified. I suggest that instead of capturing them and then infecting, the modification be introduced of standing the trap-light in a tray containing cultures, insects alighting in the cultures will infect themselves, and after leaving the vicinity of the trap will spread the infection.

A circular by GOUGH 1911 describes the method of growing and spreading the fungus recommended by him.

A circular by GOUGH 1911 goes into details of spraying against adults, giving the necessary estimates. Kerosene soap emulsion is recommended.

URICH, 1911, in an article published by the Agricultural Society, states that the froghopper has been re-identified by Professor E. D. Ball as *Tomaspis varia* Fabr.

Summary of the Literature.

From the discussion of the literature it will be seen, that little or nothing is known as to when the Froghopper first made its appearance in Trinidad in sufficient numbers to attract attention. The papers by CRUGER, written in 1863 though not published till 1902, and Francis 1872, leave a good deal of doubt as to whether they had observed the froghopper at all. There is however no doubt that in 1889 it had already done serious damage, as can be seen by HART's (1890) report. Outside Trinidad it had been recorded by MORRIS 1883, as a pest to sugar cultivation in British Honduras as early as in 1883. HART's observations in 1889 at Chaguanas were, as far as they went, quite correct. He rightly ascribed the cause of the blight to the nymphs, which by attacking and destroying the rootlets killed the canes in time. There seems to have been a cessation of the damage between 1890 and 1900, or else, what is more probable, it escaped publication, owing to the "blight" not being understood or not being properly appreciated. COLLENS reported in 1906 on the blight, and rightly ascribed it to the damage done to the roots by the nymphs, as HART had done in 1890.

In 1906 HART went back on his first opinions, and came to the conclusion, that fungoid diseases had a considerable share in producing blight, and from that date on we find a good deal of doubt in the minds of some of the many authors, of the role played by the froghopper. Barrett seems to have considered the froghopper to be merely secondary in producing blight, which he thought was mainly due to fungoid diseases, as can be seen from his recommendations.

In 1908 the Agricultural Society published a collection of articles on the Blight. The writers, HERIOT, MCLEOD, CARACCIOLO, COLLENS, BLACK, ARBUCKLE, GAUL and GILBERT all expressed views more or less decided, that the froghopper was really the cause of the trouble.

In 1909 a second collection of articles was published by the Agricultural Society. CARMODY suspects the froghopper to be attracted to unhealthy canes in preference to healthy ones. COLLENS suggests that the insects are carriers of fungus diseases. URICH reserves his decision.

In 1910 URICH and GOUGH take up the position that the Froghopper can by itself alone produce Blight, with which opinion Rorer apparently agrees.

The life-history of the froghopper has also been the subject of some discussion, and the advance in knowledge has frequently been interrupted by reversion to a wrong theory or inaccurate observation.

Eggs were first seen by MCLEOD 1908, who states their size and appearance fairly correctly, but who made a mistake in stating that they are attached to the leaves by a clear viscid liquid. CARACCIOLO 1908 erroneously believes them to be laid on the ground, this belief being at first shared by URICH 1910A. GOUGH first demonstrated eggs laid in confinement and found in the cane fields, at the September meeting of the Agricultural Society, showing that they are laid in slits made by the ovipositor of the female in the dry leaf-sheaths of canes and grasses. URICH three days later demonstrated eggs at the Board of Agriculture.

PLATE I.

A field of Cane D 156 at Brechin Castle Estate, Couva, showing the normal growth of the cane.

PLATE II.

A field of Cane D 156 at Caroni Estate, photographed at the same time of the year as Plate I, to show the effect of Froghopper Blight.

The period required for hatching is stated by URICH 1910B to be from five months in dry weather to 12 to 20 days under favourable conditions—but it is doubtful if the dates of laying can be considered correct, in my experience 12 days is too short a period.

The period which the nymphs take to mature is given by McLEOD as about 3 weeks, probably too short, URICH finds 32 to 40 days which is nearer the truth.

The cause of the damage has been rightly ascribed by HART, HERIOT COLLENS and URICH to the injury done to the root system by the nymphs. The rootlets punctured by the nymphs die, and must be replaced by the stool, the consequent waste of reserve material due to the efforts of the cane to replace the injured roots causes the blight. McLEOD alone considers the whole injury to be done by the adults puncturing the leaves; he stated that the nymphs were chiefly found on dead rootlets, mistaking the cause for the effect.

About the habits of the nymphs and adults complete agreement exists. There are however five stages of nymphs, not 4 as stated by URICH (1910B.), and owing to the sedentary habits of the females only 1 or 2 per cent. of females go to the trap-lights as against 33 per cent. as stated by URICH (1910A).

As to the remedies which have been suggested, there seems to be a great deal of agreement as to the desirability of burning the trash, by the earlier authors without adequate reason; at the same time it must be admitted that the last method has been stated to be useless by some of the practical men. The remedies will be discussed more fully later on.

Symptoms of Froghopper Blight.

The first signs of "Blight" noticeable in the cane-fields is the growing "transparency" of the leaves. By "transparency" the planter understands a fading of the green colour of the leaves to a lighter shade of green than is normal to the particular sort of cane attacked. After first becoming lighter in colour, a change in the colour itself becomes observable, and a yellowish tinge becomes apparent. Frequently leaves of blighted canes show longitudinal yellow spots or patches, $\frac{1}{8}$ to $\frac{1}{4}$ inch broad by several inches long, which seem to be caused by the tissues fading near, in front of or behind, a puncture made by some insect or other, perhaps by adult froghoppers. It is quite natural that the tissues near such wounds should show the disturbance of the balance of their nutrition more rapidly than the healthy tissues. The tips of the leaves begin to droop more than normal, the edges of the leaves roll slightly inwards, the leaves become less sappy, drier. As the blight gets more severe the lower leaves begin to wither and finally dry up. This process continues upwards, until only the top two or three leaves are green, all the rest being dry and withered. Finally if no improvement takes place even the last inmost and top leaves wither, and the top of the cane being dead, the immature portion of the haulm falls over to one side and then drops off. According to the severity of the attack the canes become more or less rapidly stunted. Sometimes if the attack has come early in the season, the cane left standing is only about two feet high, very thin with the top internodes very short and tapering abruptly to a point.

Usually the cane recovers after a short period, and does not get damaged quite so much as just described, and as long as the zone of growth is not killed a certain amount of recovery is possible. One frequently finds "blighted canes," most of whose leaves have withered, becoming green again and making fresh growth. However once blighted always stunted; and however much the cane may recover, there will yet always remain a considerable loss in weight and size.

Blighting and recovery are often noticeably periodic over a whole field, the average period between the maxima of blight or between the maxima of recovery being about two months.

TABLE I.

Cane Fields blighted on Caroni Estate during wet season 1908.

No. of Fields.	Acres.	Tons canes reaped.	Tons canes per acre.	Cost per acre.	Cost per ton Canes.
50	13.1	128 11 1	9 13 0	14.86	1.53
52	6.1	34 5 0	5 4 2	10.52	1.85
57	8·0	62 15 1	7 16 3	14·68	1.86
58	9.2	73 11 3	7 13 2	14.05	1.82
60	17.2	118 7 1	6 15 1	13.86	2.05
61	16.0	96 18 3	6 1 0	12.64	2.08
64	8.2	54 9 1	6 9 1	18.77	2.95
65	9.3	73 7 0	7 9 3	16.96	2.32
75	10.0	58 3 2	5 16 1	13.98	2.41
76	8.3	61 14 1	6 19 1	24.85	3.50
Cane Fields, partly, or slightly blighted during 1908.					
1	4.0	84 15 3	21 3 3	22.20	1.37
2	10.1	214 10 0	21 9 0	24.75	1.18
3	5.0	123 3 0	24 12 3	36.69	1.49
9	6.2	112 17 2	17 4 2	23.26	1.33
15	5.3	114 11 2	19 16 2	23.37	1.17
48	7.2	146 12 1	19 9 1	23.80	1.21
49	14.0	240 11 0	17 3 2	17.45	1.01
51	6.1	102 8 3	16 6 1	21.34	1.31
108	12.0	196 6 2	16 7 1	22.52	1.37

Caroni, (Sgd.) JAMES GILBERT.
18th December, 1910.

The loss to the planters is usually considerable. I have heard of cases where a field which should have yielded at least 30 tons to the acre has only produced two tons, and I have been informed by credible authorities of cases, where the canes have been so short as to necessitate their being gathered in baskets.

To the symptoms described above, which are the symptoms of disturbed root-functions and defective water supply, must be added the invariable presence of froghoppers in large numbers. Although in blighting or recovering fields one can almost always find all stages of the insect, yet on closer examination one notices the fact, that the nymphs are most numerous during the period of blight, adults most plentiful during the period of recovery. It will be shown later, that the life of a generation, excluding the stragglers, is about two months from the egg to oviposition. Blight is said to occur only during the rainy season, between July and December, two attacks are most frequently observed, but sometimes three distinct periods of blight separated by periods of recovery have been recorded. However it is very probable that the generations noted by their causing blight have been preceded by one or more generations which have been composed of too few individuals to do any noticeable damage; for the froghopper only causes damage when present in excessive numbers.

It is a common observation, that ratoon fields suffer more frequently than fields of plant canes, and the damage done in ratoon fields is usually much more severe than that done in plant fields. Whether this is due to greater constitutional robustness of plant canes as compared to ratoons it is hard to say, probably it is not entirely due to any such superiority of plant canes.

It has been frequently pointed out, that because a field has suffered in one year, it does not follow that it will be blighted again in the next. The more frequent observation seems to be, that fields blighted last year do well this year, frequently even without any measures having been taken to stamp out the disease.

Hart (1890) was the first to recognise that the true reason of the canes blighting was due to the persistent attacks of the nymphs on the roots, and his explanation, although rejected by himself later on, has been accepted by most competent observers. The root on which a nymph is feeding is, almost invariably, sooner or later killed by the insect for the whole of its distal length. As soon as the root is dead, the nymph moves on and taps a new, healthy root, causing it to suffer and die in turn. In consequence the stool is constantly being forced to throw out new roots, and thus waste its reserve materials. Growth of the leaves and stem is consequently stopped owing to a deficiency in the supply of water and to malnutrition. Of course a single nymph could not bring about this state of things, but in badly blighted fields it is no rare thing to observe as many as 30 nymphs on the roots of a single stool; in breeding experiments, the chief difficulty is to keep alive the plants on which the nymphs are fed.

An increased acidity of the roots attacked by froghoppers, and also of the canes themselves, has been recorded by Carmody and Collens, and the theory has been propounded by them, that the insects have been attracted by that cause. However I believe that it is more reasonable to suppose the superacidity to be due to the attack of the froghopper and not *vice-versâ*. In a similar way in McLeod's observation of nymphs on dead roots, the death of the roots was due to the attack of the insects.

The adults also do a small amount of damage by puncturing the leaves and sucking the juices. However, as compared to the damage done to the roots by the nymphs, the injury caused to the leaves can be considered as trivial, because in this case the cane is not forced to waste its reserves in producing new tissues nor is its food supply tapped and temporarily stopped in the same way.

There is no evidence to show that fungoid diseases of the cane predispose it to an attack by froghoppers, though the opposite can readily be imagined to be the case. Fungoid parasites can more readily obtain a footing on a plant, whose vitality has been lowered by an attack of the insects, and the punctures on the roots and leaves may readily serve as ports of entry for wound parasites.

Blighted canes, when they come to the factory, contain less moisture (hence often higher percentage of sucrose) and also a greater acidity. The greater dryness causes extraction and crushing to be less effective than in normal canes, though the higher percentage should render manufacture more easy.

The shortness and uneveness in size of the canes sometimes causes trouble in milling, requiring a great deal of extra attendance in feeding the mill. Blighted canes are softer and more spongy than healthy canes, in consequence they do not pass so well through the mill, as the rollers fail to grip properly. The higher acidity necessitates greater admixture of lime to the juice for clarification, this again requires an increased mixture of phosphoric acid to decolorise. The resultant sugar is at the best lighter than desired (when making yellow crystals) and naturally commands a lower figure when sold.

I am told that in the factory in dealing with blighted canes it is usual, when making yellow crystals, to pass in small quantities of blighted canes together with large amounts of normal canes, in order to make the resultant sugar of as high a grade as possible; or else it becomes necessary to manufacture from the blighted cane separately, and produce a lower grade of sugar.

A further drawback of blighted canes in the factory is stated to be that the sucrose in the juice inverts more readily than in normal cane juice. This necessitates quicker working, and often leads to a loss of crystallisable sugar.

When working with blighted canes alone, feeding the mills requires much more attendance than when normal canes are being crushed. The short canes are very apt to fall down the shoots in heaps and to stack in front of the rollers, causing the mills to run empty until the heaps have been raked apart. The juice is very acid, and takes a larger quantity of lime than normal. Inversion as already stated is very rapid, and should anything happen to stop the mills or the factory, it would still be necessary to go on condensing the juice to avoid losing all the crystallisable sugar; this means an extra expenditure on fuel. Normal cane juice on the other hand could be left for as long as 12 hours to itself after being brought up to boiling point and treated with salicylic acid or other preservatives. In manufacturing "blighted" juice, it is further often necessary to run lime in the juice when it is in the vacuum pans. If on the other hand one should spare the lime, one runs the risk of the sugar becoming "stringy" and not crystallising properly. There seems also to be evidence to show that blighted cane juice tends to give more molasses and less sugar,—again a substitution of an inferior product for a superior one.

Further, it is stated that it takes a greater weight of blighted canes to give one ton of sugar than it does of normal canes; and as the resultant sugar is of less value the damage is all the greater. This in spite of a higher percentage of sucrose in the blighted than in the normal canes.

Life History of the Froghopper.

The life cycle of the Froghopper lasts, during the wet season about two months, but it is probable that this can be increased to four or five months should the eggs have been laid during or just before the dry-season. After passing through the egg-stage, it undergoes five nymphal stages before reaching maturity.

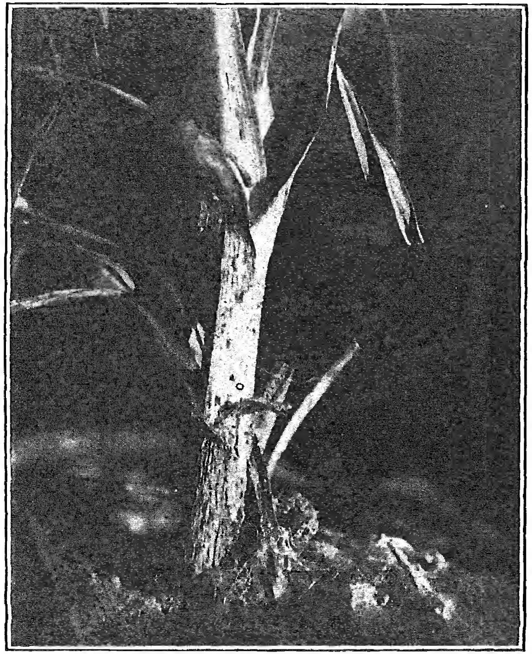
The Eggs.

The Froghopper lays its eggs in the dead tissues of the leaf-sheaths and occasionally also of the leaves, of sugar-canes and of almost any variety of grass. On canes the favourite site is in the two bottom outer flaps of the leaf-sheath of the lowest leaf, especially if that portion of the sheath is somewhat wet in addition to being dead. In grasses any portion of the leaf-sheath can be utilised, or even the base of the blade if withered. Green leaves or living leaf-sheaths appear to offer an obstacle to the penetration of the ovipositor sufficient to prevent the normal laying of eggs in them.

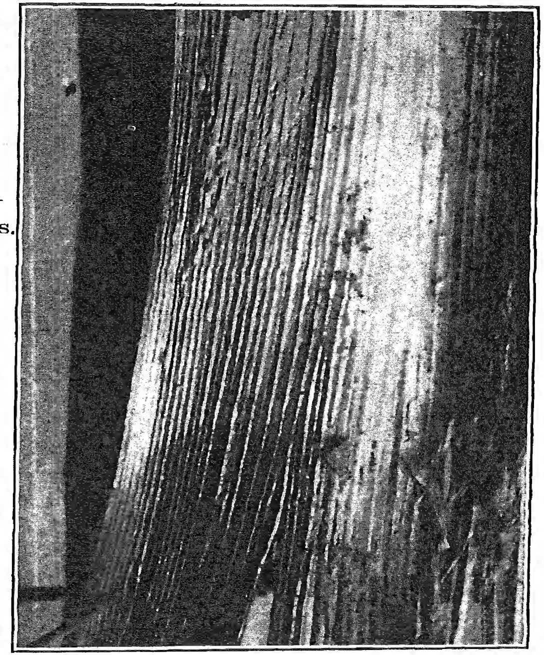
In laying its eggs, the female first cuts a small slit in the tissue of the dead leaf, and then deposits its eggs in the slit. The egg very often projects right through the tissue, and is then very apparent on the inner surface of the leaf-sheath of cane, when laid in grasses it probably lies almost free between leaf-sheath and stalk. However, a portion of the egg appears invariably to project through the slit on the outer side of the leaf-sheath, and it is on this outer surface that the hatching lids appear later on. The eggs lie normally in a diagonal position as regards the vertical axis of the cane, their anterior pole facing outwards and upwards.

This enables the hatching nymphs to crawl or fall clear of the leaf-sheath; they might get lost and die if they were to fall into the cavity between the leaf-sheath and the cane. The eggs are usually found in little groups of up to twenty or more, often one egg just behind the other in a vertical line, and frequently in several parallel rows, of course the rows are all in the soft tissues between the vascular bundles. This arrangement goes far to show, that a female lays all its eggs at one time not one at a time at intervals as has been suggested by Urich.

PLATE III.



Eggs of the Froghopper on a stem of a nut-grass. Magnified.



Eggs of the Froghopper on Cane trash. Magnified.

The eggs themselves are very small, just recognisable with the naked eye. The eggs are oblong, about three times as long as broad measuring ·75 mm by ·26 mm. When quite newly laid they are uniform, bright yellow in colour; as they mature the colour becomes more an opaque whitish yellow. Before hatching the so-called hatching lid becomes visible; this is a V shaped structure, the broad end of which is towards the apex of the egg, the sharp narrow end near the middle of one lateral surface. The whole lid is dark black in colour, and contrasts very vividly with the lighter colours of the rest of the eggs. When hatching, the lid opens by a slit bisecting the lower angle of the lid.

Normally, in nature, the outer end of the egg, where it peeps through the leaf-sheath into the open air is the place where the hatching lid develops. I have however seen the lid to form on the surface of the egg which would have been between the leaf-sheath and the stalk of the cane, in the case of some eggs on a piece of trash which had been kept for some time in a glass tube in the light. It would seem probable, that the hatching lid is formed on that surface of the egg exposed to light.

The surface of the newly laid egg is minutely granulated, the granules being largest at one of its ends.

The period required for hatching varies apparently according to the amount of moisture present in the plant tissues surrounding the egg. Some eggs kept moist, hatched just 27 days after being laid, (September 11th to October 8th), other eggs laid on the same day and kept in the same tube were hatching until 9 days later (October 17th). In this case there is no doubt that all the eggs were laid on the same day, though perhaps by different individuals. The experiment shows that even under the same conditions, the rate of development of the eggs varies considerably individually.

The period required in dry weather is probably considerably longer. Urich states that some eggs collected in February hatched in June after exposure to rain. In this case, there is however no record if the eggs really were laid in February or if earlier, as the experiment recorded by him apparently refers to the date of collecting trash and of the hatching from it of eggs, which had not actually been observed, and whose age was of some date previous to the collecting of the trash. This observation which is probably correct within the above limits, shows that eggs can lie dormant under dry weather conditions for four or five months before hatching. As shortest periods Urich (1910 b) mentions 12 to 20 days, but in each case there is room for doubt about the actual date of their being laid.

The Nymphs.

The froghopper passes through five nymphal stages before reaching maturity. Each of these stages differs structurally from the rest, allowing the stage of any specimen to be readily determined. The following key will serve to identify them with ease.

(1.)	Wingless	Stage I.
	Wing rudiments apparent	2.
(2.)	Wings broader than long	Stage II.
	Wings at least as long as broad	3.
(3.)	Wings not twice as long as broad	Stage III.
	Wings more than twice and a half as long as broad	4.
(4.)	Wings grey, smooth, abdomen not hairy ...	Stage IV.
	Wings showing colours of mature insect, legs and body hairy	Stage V.

The key has been based entirely on the wings, the most easily observed structure; it could have been made equally well using the antennæ or the eyes as a guide.

Stage I.—Wingless, antennæ with two large basal joints and 3 distal joints forming a filament. Eyes facetted only over a narrow oblong vertical portion, proboscis more than half the length of the body.

The nymphs of the first stage after hatching wander until they find a cane or grass rootlet to which they attach themselves and feed, boring their proboscis into the tissue of the rootlet. Some specimens kept under observation did not form any froth until after having fed, 24 to 48 hours after hatching. The froth masses formed by the first stage nymphs are very small, 3 mm. to 5 mm. in diameter, and are composed of very minute bubbles. The nymphs of this stage like those of other stages cannot actively burrow, but follow the grass or cane roots through cracks in the soil, or between loose particles of the soil. This stage takes at least 12 days to mature to moulting into the next stage (4th to 16th November). (Urich gives 12 to 15 days).

Stage II.—Wing rudiments present, much broader than long, 4 distal joints to antennae, proboscis less than half the length of the body. Facetted portion of the eye red, larger, the short (horizontal) axis having increased. Froth masses about 7 mm. in diameter, bubbles small, but larger than Stage I.

The habits are much the same in all the stages. Nymphs normally avoid light, and have a tendency to hide away.

Stage III.—Wing rudiments smooth, grey, about twice as long as broad, antennæ with 5 distal joints, the facetted portion of the eye red, has again increased in diameter. Duration of stage about 6 to 10 days (6th to 16th November and 6th to 12th November).

Stage IV.—Wing rudiments length $5\frac{1}{2}$ by 2 breadth, smooth, grey, abdomen, eyes, legs, smooth, antennæ with 6 distal joints. The red facetted portion of the eyes has again increased. Duration of the stage about 8 days. (4th to 12th November).

Stage V.—Wing rudiments of the same proportions as in the last stage, but with the colours of the adult. Wings, abdomen, legs, eyes, hairy. Antennæ with 7 distal joints. The facetted portion of the eyes red, and now nearly covers the whole eye.. Duration of stage very short, only 2 or 3 days.

Having reached its full term the nymph of the fifth stage leaves the roots of the cane and climbs upwards, mounting up to one foot above the ground. Here it forms a small mass of froth, in which it sheds its skin for the last time. Emerging usually in the morning or at mid-day, the mature insect remains for sometime within the froth, until its wings and skin have had time to harden. By the time the insect is ready to leave the froth, this substance has hardened and dried, and no longer adheres to the insect, although still retaining the structure and appearance of froth.

Although the nymphs normally live on the roots of their food-plants, they can quite readily be made to feed on the leaves instead, and yet develop normally.

The nymphs are quite active, moving readily from one place to another; in my experimental cages they have been observed to travel distances of one foot in search of food.

Each nymph is surrounded by the froth it has produced as in a cocoon, when on the march they desert their froth concealment, producing another mass of froth as soon as they have taken up their new quarters. After changing their skin they usually desert the old froth and produce a new mass of it elsewhere.

Collens has shown the froth to contain potash. It must be very rich in solids, as can be seen by its retaining its shape and appearance on drying out.

The nymphs are found not only at the surface but also quite under the cane stool, yet they are not able to dig their way, but must follow cracks in the soil. They are especially frequently found under the heaps of rotting trash between the cane rows.

They do not seem to evince any predelection for any particular species of cane or grass root. Nymphs taken from cane roots can be reared on grass roots and *vice-versâ.*

It has already been pointed out that the nymphs damage and kill the roots they are feeding on, and that after having killed their food-root, they wander in search of another; and it has been stated already that in consequence of their ravages, the juices of the roots and finally of the canes themselves become more than normally acid, the canes grow stunted, and are spongy in texture instead of crisp and firm.

The Adults.

Length about 7½ mm. from the front of the head to the apex of the tegmina, shape oblong ovate. Head and thorax black with greenish bronze lights. Pronotum, scutellum punctate, abdomen dark brown, legs black, the last pair sometimes dark brown. Coloration of the tegmina rather variable, usually very dark brown or chocolate with two yellowish transverse bars situated at about ⅓rd of the tegmen and at ⅔rds. In addition there is usually a slanting yellow mark running from the shoulder to behind the scutellum forming a V shaped mark together with its fellow of the other wing. This V shaped mark is frequently totally absent, and also occasionally developed to such an extent as to merge into the anterior of the two yellow transverse bars. When the V mark is absent, the two transverse bars are frequently reduced to mere spots on the outer margin of the tegmina. Apices of the tegmina reticulate.

The Trinidad Cane Froghopper was formerly identified as *Tomaspis postica* (Walk.) by the earlier authors. Collens (1909b.) states that specimens had been identified by the United States Department of Entomology as *Tomaspis postica* (Walk.) Specimens sent by Urich to Prof. E. D. Ball have recently been identified as *Tomaspis varia* Fabricius. (URICH 1911a.) The species certainly differs from *T. postica* (Walk) in the following points—

The ground colour of the tegmina is a dark chocolate brown in our specimens, in Fowler's specimens it is better described as bluish black. Fowler figures the apex of the tegmen brown, contrasting fairly strongly with the rest of the tegmen, such a contrast is hardly noticeable in our species. The scutellum in Fowler's figure is bluish-black, contrasting with the greenish-black of the pronotum, in our species both are greenish-black. I have not been able to obtain access to a description or a figure of *T. varia* Fabricius, and cannot consequently give any opinion on the correctness of the more recent identification.

The adults feed on the juices of the leaves of canes and grasses. During the day they are to be found in the angles of the top leaves, or in the space enclosed by the inrolled edges of the youngest leaves of the canes, or on the stalks and leaves of grasses. I believe that canes are preferred to grasses, because they offer greater chances of concealment in semi-darkness. Resting quietly during the day, they become active in the evening when they leave their hiding places, and may be seen walking about the leaf blades of the canes and occasionally flying short distances, especially if disturbed.

When resting in the angle of a cane-leaf, or a grass-stalk, in an experimental cage, or on any object offering sloping or vertical sides, they invariably sit head upwards, (negative geotropism).

They are attracted to light of low intensity only, this causes them to hide in the leaf-sheaths during the day, when they hide from the strong light. At night their phototropism leads them to weak lights; this has been used in attempts to exterminate them by means of trap-lights. Some experiments that were made with strong lights failed to succeed in catching, on the other hand the light of an ordinary stable lamp or hurricane lamp has always proved most attractive. In experimental cages males and females respond almost equally readily to

the influence of a weak light. An experiment was made on 9th August with 50 males and 44 females to study their phototropism. They were placed in two cages, males in one, females in the other. The cages were 2½ feet long, with sides 9 inches high, floor and lid 9 inches wide. All the sides except one of the small square sides were wood, or glass covered with wood, one of the ends was made of a pane of glass. At the other end of the cage was a pot of grass for food and as counter attraction to the lights. The insects were introduced from the end with the pot. After dark the two cages were placed with their glass ends side by side, and a candle was placed at a distance of about nine feet. After half an hour it was found that 24 of the males (48%) and 16 of the females (about 35%) were settled on the glass.

The results obtained in the field in studying the phototropic re-action of the females yields very different results. In order to ascertain the value of trap-lights as a method of control, a large number of samples of trap-light catches have been examined, the sexes determined and the proportions worked out. Instead of catching about 42% of females and 58% of males, which would have been the result of the experiment, above described, only a very small percentage of females (1⅓%) are caught, as can be seen from Table 2.

TABLE II.

Result of Trap-Light Countings.

Locality.		*Date.*		*Males.*	*Females.*	*Per cent. of Females.*
Rivulet	Estate	...August	10th	32	1	3
Rivulet	,,	... ,,	11th	20	0	0
Spring	,,	... ,,	12th	40	0	0
Rivulet	,,	... ,,	12th	8	0	0
Exchange	,,	... ,,	12th	15	0	0
Milton	,,	... ,,	13th	39	0	0
Caroni	,,	... ,,	13th	1,131	11	1
Milton	,,	... ,,	15th	39	0	0
Caroni	,,	... ,,	15th	445	9	2
Chaguanas	,,	... ,,	15th	1,250	3	¼
Tarouba	,,	... ,,	15th	566	11	2
Chaguanas	,,	... ,,	16th	453	3	1
Caroni	,,	... ,,	16th	967	12	1
Tarouba	,,	... ,,	16th	583	15	2½
Chaguanas	,,	... ,,	17th	494	4	1
Tarouba	,,	... ,,	17th	396	15	4
Spring	,,	... ,,	17th	7	0	0
Caroni	,,	... ,,	17th	1,185	25	2
Rivulet	,,	... ,,	18th	39	0	0
Tarouba	,,	... ,,	18th	263	8	3
Chaguanas	,,	... ,,	18th	1,520	24	1½
Caroni	,,	... ,,	18th	1,233	25	2
Tarouba	,,	... ,,	19th	304	5	2
Tarouba	,,	... ,,	20th	265	4	1½
Tacarigua	,,	... ,,	24th	584	6	1
Tacarigua	,,	... ,,	25th	932	7	1
Brechin Castle	,,	...Sept.,	15th	111	4	3½
Harmony Hall	,,	... ,,	13th	788	6	1
Caroni	,,	... ,,	16th	1,580	16	1
Chaguanas	,,	... ,,	16th	1,321	18	1⅓
Caroni	,,	...Novr.,	8th	2,909	34	1
Harmony Hall	,,	... ,,	11th	1,423	11	1
Harmony Hall	,,	...Decr.,	15th	30	0	0
Total of all localities and dates			...	20,972	277	1⅓

This result does not agree with URICH's (1910 a) statement that about ⅓ of the catch of a trap-light are females. As he does not give any figures to bear out his statement, and as he has subsequently (URICH 1910 b) to my publication of trap-light results (Gough 1910 a) withdrawn his recommendation to use trap-lights as a means of froghopper control, it can be taken that the proportions he gave are recognised by him as being incorrect. It seems hardly probable, taking the large number of samples tabulated on Table III into consideration, and seeing the remarkable uniformity of the results of large and small catches there recorded, that the females should have been present in the only sample (or samples?) he examined to the extent of 33 per cent. The proportions of males and females taken by trap-light is however of very great economic importance.

The actual proportion of the sexes in the field is more difficult to estimate rightly, but I am of the opinion that they are more equally balanced, but that the males are somewhat in excess of the females.

The actual numbers of males and females recorded, caught by hand, are to be seen on Table III, on the same places where trap-lights had been used the night before.

TABLE III.

Proportion of Sexes in Hand Caught Samples.

Places.	*Date.*	*Males.*	*Females.*
Rivulet ...	...August 10th ...	29	48
Rivulet ...	... „ 11th ...	50	75
Spring ...	... „ 11th ...	50	51
Exchange...	... „ 12th ...	14	20
Milton ...	... „ 13th ...	35	40
Brechin Castle	... „ 15th ...	4	8
Spring ...	... „ 15th ...	26	33
Harmony Hall	... „ 15th ...	328	327
Spring ...	... „ 16th ...	28	40
Caroni ...	... „ 16th ...	38	35
Spring ..	... „ 17th ...	27	25
Caroni ...	... „ 17th ...	170	127
Rivulet ...	... „ 18th ...	25	26
Tarouba ...	... „ 18th ...	311	386
Caroni ...	... „ 18th ...	191	181
Chaguanas	... „ 18th ...	97	113
Spring ...	... „ 19th ...	34	39
Chaguanas	... „ 19th ...	257	212
Spring ...	... „ 20th ...	18	14
Tarouba ...	... „ 20th ...	366	459
Totals ...	... ...	2,098	2,259

According to this table the females are somewhat in excess of the males, but that excess is due to two factors. The fields where these samples were taken had been trap-lighted the night before, and in some cases for several nights, which would naturally reduce the number of males.

Besides this, even if the males were present in excess of the females (as they undoubtedly are) hand caught samples would either fail to show it or not show it to the full extent for the reason that the males are much more active than the females, and consequently less readily caught.

The only reason I can imagine to account for the females going to the light-traps in such small numbers as shown in Table I is, that they are much more sedentary in their habits, and do not wander so far as the males, a common observation where insects are concerned. For the same reason, when catching by hand in the field more females will be caught in proportion than strictly ought to be.

I have on some occasions, when collecting froghoppers to use in egg-laying experiments, found the proportion of the males in excess of the females as 2 to 1. But there is little regularity in any successive catches, much depending on the skill of the collector. (The catches tabulated on Table II were made by coolie children). For instance I caught on September 9th at Tarouba 50 males and 44 females. On another occasion at Brechin Castle, (on 26th October) I collected 18 females and 55 males, on this occasion I only missed catching very few of those I saw. I consequently place very little reliance on the figures given on Table II as the excess of females is probably due to the sexes not being caught in the proportion in which they were actually present.

The sedentary habits of the females as deduced from the figures and reasons given can be further deduced from observations made by many observers of the peculiar restriction of the area blighted in some places. It is an old observation, that very often one field is badly blighted, whereas the next field, divided from it only by a trace, is quite healthy; and cases are recorded, and others have been seen by me, where one half of a field has suffered severe damage whilst the other half has escaped, although the whole field was planted with the same kind of cane and had received the same treatment and attention. The explanation which appears to me to be most reasonable to account for these facts is based on the sedentary habits of the females. The females remain all their lives on or near the same spot, and lay all their eggs in small groups on one cane. The eggs hatch out, the nymphs feed on the roots of the stool bearing the cane the eggs were laid on, they mature, crawl up the canes of the same stool, copulate there, and finally the females lay their eggs on the canes of the same stool. The males may fly away in search of females, the females remain to lay their eggs on the plant which supplied their own food. Thus the damage done to any particular part of a field increases in severity as the season goes on, yet the area damaged does not necessarily spread rapidly. Occasionally of course a female wanders and if carried by the wind may go to some distance and start a new centre of destruction.

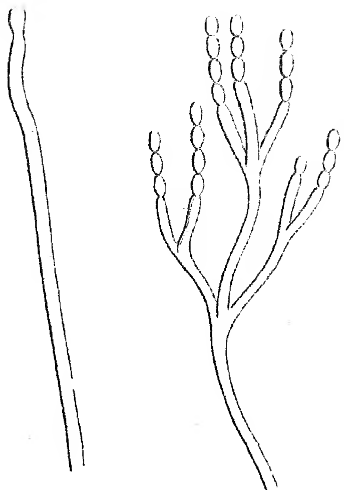
Copulation takes place often during the day, or in the evening. The couples sit side by side on the leaves or in their angles during coition, invariably with their heads uppermost. Copulation can last for a long time, over half an hour.

The life of an adult can under favourable circumstances last for over one or two weeks. Males sometimes survive copulation for a few days, more often they die soon after.

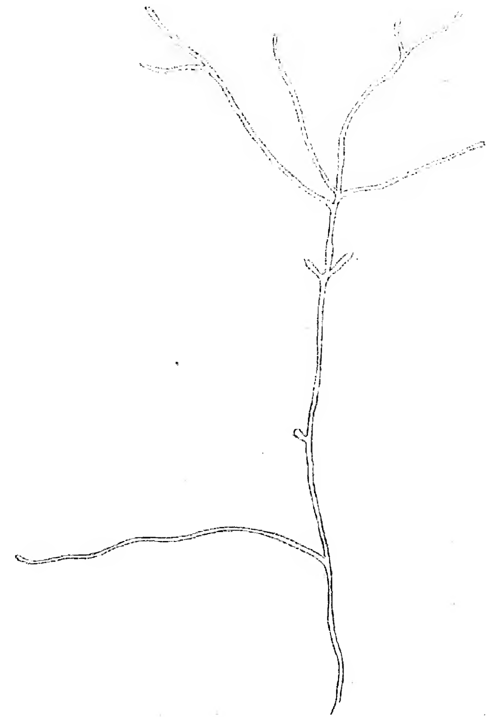
Natural Enemies and Diseases.

The Froghopper is sought for and eaten by many birds, toads, tree-frogs, scorpions and spiders. In its nymphal stage it falls a prey to the larva of a dipterous fly, which can often be found in the masses of froth in company with a recently killed or more or less devoured nymph. No attempt was made to breed out the fly belonging to the larva, as it seemed improbable that it could be reared in sufficient numbers to make it usable economically.

The most important natural enemy is however a mould, which was already observed by Hart in 1889 and recorded by him (Hart 1890) as destroying a number of these insects at Chaguanas. It has since been seen and recorded by Barrett, Collens, Carmody, Urich, Rorer and Gough. I have found insects attacked by it at Caroni, Chaguanas, Harmony Hall, Tarouba, Waterloo, and have been instrumental in spreading it at Brechin Castle. It has been identified by Rorer (1910 B) as *Metarrhizium anisopliæ* (Metschnikoff) Sorokin, and I am here adopting his indentification, without however having been able to verify it.



Hyphae and Sporophores of the froghopper fungus



Hyphae of the froghopper fungus

The hyphæ are irregularly branched, septate at long intervals; they measure about 0·0025 mm. thick. They form a dense felted mass on the medium they are grown on, usually very pure white in colour, but occasionally yellow, when grown on potato in contact with water, (or when grown on sweet potato, Rorer). The sporophores arise immediately from the hyphæ, and like them are irregularly branched, or occasionally simple. The spores are cut off from the ends of the hyphæ, in long chains, they are cylindrical, rounded at the ends, measuring from about 0·0045 mm. to 0·007 mm. long by 0·0023 mm. to 0·0025 mm. broad. The sporophores grow very densely packed, the resultant chains of spores being stuck together to form prismatic masses, often up to to 2 or 3 mm. thick. The spores, sown on bouillon-agar germinate after 4 hours (Rorer, 4 to 6 hours), the hyphæ growing out of one end of the spore, (occasionally at both ends, Rorer 1910 b).

When a froghopper has been killed by the fungus the hyphæ appear soon after the death of the insect, first between the abdominal segments as white lines which increase in breadth, join each other and finally cover the whole abdomen, the thorax and head begin to be covered by the white hyphæ, and then hyphæ push their way out between the wing-cases. At this stage spore-formation is in full swing; the hyphæ become covered with olive green masses of spores. After a long time the entire insect is completely covered by the olive coating of spores. Diseased froghoppers almost invariably die in the angles of the leaves, or on the underside of the leaves an inch or two from the stem.

The cultures vary considerably according to the medium they are grown on. They grow most luxuriantly on potato, peas or rice. The growth becomes visible as a white streak or white patches along the inoculation line two days after inoculation. The streak widens, and thickens forming a cushion up to 1 or 2 mm. thick. After from 4 to 7 days small green spots are formed on the surface of the white cushion, except at the margins where it is growing most rapidly. The spots coalesce forming an olive green crust covering the whole of the hyphæ lawn with the exception of its margins to a depth of up to 3 mm. the green substance being formed of spores. In time the fungus overgrows the whole surface of the potato-cylinder and finally after about 3 weeks, is entirely covered with spores. Kept longer one observes the hypæ growing in long tufts above the surface of the spores, the tufts reaching as much as 2 c.m. long, and often spreading in a fan-shaped mass.

Grown on bouillon-agar the growth obtained is similar, but never so luxuriant as on potato. The masses of spores then seldom exceed 1 mm. in thickness.

Grown on cane-cylinders, or on cane juice agar, the fungus produces hyphæ, but has not produced spores in 3 months. However if the cane juice is neutralised, spores are formed within a couple of weeks. Neutralised litmus cane juice agar became acid by the time spores commenced to form. (Neutral bouillon agar remains neutral).

It was not possible to infect rats or mice by inoculation or by feeding with spore material.

Froghoppers attacked by the fungus become more or less torpid and inactive, and finally die from the infection. By experiment it was shown that the course of the disease takes from 3 to 8 days, almost invariably ending fatally.

On August 30th, 2 adults were placed for five minutes in an empty test tube, which had contained a "mouldy" froghopper overnight. They were then transferred to a cage with a cane growing in it. Both were dead on September 2nd their bodies were placed in sterile test tube, the fungus was observed growing on them on August 16th.

On August 30th, 4 adults, (2 males and 2 females) were shaken up with a mouldy froghopper in a sterile test tube. They were then transferred to a breeding cage containing a growing cane. One died September 2nd, on September 5th one female was still alive, on September 7th all were dead. The fungus appeared on the bodies and a pure culture was isolated from spores obtained from one of them.

On September 2nd, three males and two females were infected by applying spores from pure culture with needle, they were then placed in a breeding cage with growing cane. On September 5th one male and one female were dead. On September 7th all were dead. The fungus was produced on all the bodies.

On September 6th, several nymphs were inoculated (by needle) from a pure culture and placed in glass cylinders on grass-roots. Two hatched as adults on September 7th and were transferred to a breeding cage with growing cane. Both were found dead and mouldy on September 11th, (no examination could be made on the 9th and 10th). All the larvæ remaining were dead and mouldy on September 11th. The controls in a similar tube were alive and healthy.

On September 18th, a *Stomoxys* sp. was placed in the tube which had contained nymphs killed in the above experiment. On September 25th the fly was seen to be dead, and a vigorous growth of the fungus was observed on September 29th.

On October 5th, four nymphs of a *Tettigonia* related to *Tettigonia psittacella* Fowler but somewhat larger and with green head, legs and thorax, were infected from a pure culture by the needle and placed in a cylinder containing a growing *Hibiscus* twig. October 8th two dead, October 10th all dead, fungus growing vigorously. A pure culture was isolated from one of them.

On October 10th some nymphs, well established on the roots of a growing cane near my laboratory were taken into experiment, their froth being dusted over with spores taken from a pure culture till green. Although the experiment was kept under observation for about 3 weeks, no resulting infection was observed.

The experiment was repeated 24th October again with negative result.

On 25th October six frothers were placed on cane-roots after infection by needle.

On 1st November four were mouldy, 2 still alive.

These experiments agree in their results fairly well with RORER's (1910 b) experiences. RORER infected his adults by spraying spores that had been shaken up with water over them. Of 50 sprayed with spores on August 4th 1910, all were dead on August 9th, 19 mouldy insects being recovered, the rest had been carried away by ants. RORER succeeded in infecting nymphs by blowing spores over their froth. His nymphs were kept in a moist chamber, on cane roots which had been rooted in moist saw-dust. His experiment was carried out a few hours after introducing the nymphs. As I have not succeeded in producing infection of well established nymphs, I can only suggest that in this case the insects had not been given time enough to settle down and were still wandering a little. Perhaps the cane being rooted in saw-dust may have caused them to exhaust the rootlets sooner than happened in my experiment. By wandering through, or even near to, the infected surface of the froth the nymphs would be liable to infect themselves.

Having proved to my own satisfaction that artificial infection is possible on an experimental scale, it was attempted to spread the infection in the field. Tramway tree field at Brechin Castle, Couva, proved

an ideal spot to carry out infection experiments. I had drawn all my experimental material of froghopper from that field, and had collected through it on many occasions, without ever finding a single "mouldy" froghopper in it. It could consequently be considered to be free from natural infection. My cultures were derived from "mouldy" froghoppers found at Chaguanas and Tarouba.

On September 24th seven cultures on potato were exposed on bamboo sticks, 6 feet from the ground, to the windward of Tramway tree field. No result came of this experiment, although the field was examined on several occasions.

On October 4th the spores from 16 potato tubes were mixed with 1 lb. of flour, and sprayed over one-tenth of an acre at Tramway tree. The spraying was effected by a powder bellows. A sharp shower of rain fell within 15 minutes of spraying. On October 8th no result could be found. On October 10th a few dead froghoppers were found, but there was no evidence of their having been killed by the fungus, and the fungus did not develop on them when kept in a sterile test tube.

On October 18th this experiment was repeated, the spores from cultures grown in 4 Erlenmeyer flasks (750 cc. capacity) were mixed with 1 lb. flour, and sprayed over one-twentieth of an acre. The flour was grey in colour after mixing. On October 24th no result could be found. On October 26th several (six or more) mouldy froghoppers were found in the area sprayed.

On October 10th and 11th fungus cultures on small chips of potato were exposed in the angles of the cane leaves in a portion of Tramway tree field. On October 24th and 26th several "mouldy" froghoppers were recovered from this portion of the field.

On October 24th rice with fungus growing on it was distributed in another portion of the same field. On November 6th the field was examined, and the fungus was seen to be spreading very rapidly amongst the froghoppers, several dead ones being found on almost every cane. On the same date the potato chips of the last experiment were examined and found to be still covered with spores of the fungus.

My experience in the field with rice and potato has been, that the rice is more liable to be eaten and carried away by ants or other insects, than the potato chips.

These experiments show, that it is quite possible to spread the fungus disease in places where it was not previously present; it should also be quite feasible to intensify a natural epidemic. Of the three methods employed by me, the last was attended by the best results, the mortality being very much higher than that produced by the dusting out method.

Rorer has only made one experiment in the field. On this occasion the spores from the six flasks were mixed with 12 ozs. of flour and dusted over 100 canes where froghoppers were abundant. "Despite the fact that immediately after the spores were scattered, there was a very heavy downpour of rain which must have washed many of them away, the effect of the inoculation could be seen after a week's time. Although insects attacked by the fungus were found on the surrounding canes, fully 50 per cent. more dead ones were found in the inoculated area. These experiments leave no doubt that the fungus is capable of killing larger numbers of froghoppers."

The methods of growing the fungus and spreading the disease will be discussed more fully latter on.

Geographical Distribution of the Species.

The Sugar Cane Froghoppers occurs in Trinidad, Tobago and Demerara (Quelch *vide* Urich 1910 b).

In Trinidad it occurs practically everywhere. It is found on grasses in the high woods far up the mountains, it is common on the grasses in the cacao plantations, and occurs on grasses in coconut plantations at sea-level. It is specially common throughout the sugar area, infesting canes and grasses, on the traces as well as in the beds. The damage done in the sugar area, and consequently the abundance of the insect, appears usually to be greatest in the northern portion at Caroni, and gets less and less proceeding southwards through Chaguanas, Couva to Harmony Hall and Tarouba.

The insect is not common in Tobago, I examined fields in Mount Irvin, Sherwood Park, Auchenskeoch estates without finding specimens, two were found after long search at Bacolet estate near Scarborough. In Tobago one hears no complaint about blight in the canes, perhaps because of the small amount of interest taken by the sugar growers there in their crops, which is very noticeable in their utter neglect of the sugar fields.

Methods of Controlling the Froghopper.

The damage done by the froghopper has already been shown to be very serious. It is impossible to give an average value for the damage, as this varies considerably from year to year, and figures are almost impossible to obtain. The loss on the worst fields is easily realised, but many fields may be affected, where the loss is less evident; in extreme cases only 2 tons per acre have been reaped, instead of 20 tons; the average loss appears to be about 10 tons to the acre. Where the blight has not been severe perhaps small quantities, say 2 tons, will be lost, in getting estimates such fields would probably not be recorded.

To show the actual amount of damage possible, it can be stated that this year (1910) 150 acres have been blighted on one estate, placing the average loss at 10 tons to the acre, this would represent 1,500 tons of cane valued at $3,000 or a loss of 150 tons of sugar valued at £12 a ton representing a loss of £1,800 from this year's income, for one estate alone.

The loss incurred by froghopper blight is however very often not only a loss of revenue due to a decreased yield of sugar per acre, but also a loss of capital expended to grow the crop. This loss varies considerably if the blight appears early in the season, or late.

The usual plan hitherto, to prevent loss of capital on a blighting field has been to stop all operations at the first sign of the blight. Then if the yield per acre is reduced by the blight, it will be found that the cost of growing the canes has also been reduced. Thus, if a field blights early in the season, and the resulting crop is only a few tons, the cost of producing the crop remains more or less proportionate to the amount reaped. It is a much more serious matter if the blight appears later in the season. Then money will already have been spent on cultivation to an extent out of proportion to the size of the resulting crop, and a direct loss of capital will ensue in addition to the loss of revenue.

Table IV is given to show the actual expenditure on a field at any period of the year.

TABLE IV.

"Caroni" Estate—Field No. 24.—"Plants" D. 109—12a. 2r. 0p.—Canes reaped—490t. 3c. 1qr.

Date 1908.		Steam Ploughing.	Sub-soiling.	Planting.	Brushing.	Banking.	Forking.	Draining.	Weeding.	Dig Para Grass.	Liming.	Artificial Manure.	Pen Manure.	Total Cultivation.	Reaping.	Grand Total.	Cost per acre.	Cost per ton.	Crop—1910.
April	4	9 70	...	...	22 80	...	...	...	...	...	...	...	...	32 50	...	...	...	...	
"	11	17 45	...	...	...	...	...	...	...	...	...	...	...	17 45	...	...	...	...	
August	15	65 50	...	...	...	...	...	...	...	36 00	3 20	...	...	104 70	...	...	...	...	
"	22	...	...	...	...	...	...	...	...	36 65	...	...	...	36 65	...	...	...	...	
"	29	...	...	...	16 00	...	...	...	...	...	1 75	...	...	17 75	...	...	...	...	
September	5	...	2 40	...	...	39 00	...	...	...	...	...	...	...	41 40	...	...	...	...	
"	12	...	...	26 50	...	...	...	72 00	...	...	...	...	...	98 50	...	...	...	...	
November	7	...	...	...	...	...	...	...	...	3 00	...	...	...	3 00	...	...	...	...	
"	14	...	...	...	...	...	...	...	48 55	33 91	...	...	...	82 46	...	...	...	...	
"	21	...	...	...	...	...	...	...	...	...	...	...	47 25	47 25	...	...	...	...	
"	28	...	...	...	...	...	...	...	...	...	...	...	31 60	31 60	...	...	...	...	
1909.																			
January	30	...	...	...	...	...	...	...	6 20	...	...	...	...	6 20	...	...	...	...	
February	6	...	...	...	...	...	...	...	35 50	...	...	...	...	35 50	...	...	...	...	
"	13	...	...	...	...	...	...	...	5 00	...	...	...	...	5 00	...	...	...	...	
June	12	...	...	...	...	...	...	...	14 85	18 83	...	...	...	33 68	...	...	...	...	
"	19	...	...	...	...	...	...	...	29 60	...	...	1 70	...	31 30	...	...	...	...	
1910.																			
April	2/9	...	...	...	...	...	...	...	...	...	...	75 00	...	75 00	154 50	...	...	...	T. C. Qr.
Total	...	92 65	2 40	26 50	38 80	39 00	...	72 00	139 70	128 39	4 95	76 70	78 85	690 94	154 50	854 44	68 35	1 74	Return per acre 39 4 0

"Caroni Estate"—Field No. 23.—D. 109 1st Ratoons—12a. 0r. 0p.—Canes reaped—246t. 5c. 0qr.

Date 1909.		Forking.	Weeding.	D'Grass.	Artificial Manure.	Total Cultivation.	Reaping.	Grand Total.	Cost per acre.	Cost per ton.	Crop 1910.
May	15	33 00	...	...	60 00	93 00	...	...	...	...	
"	22	31 60	...	...	...	31 60	...	...	...	...	
June	19	...	...	...	5 15	5 15	...	...	...	...	
July	31	...	32 50	...	...	32 50	...	...	...	...	
August	7	...	...	...	2 75	2 75	...	...	...	...	
1910.											
March	12/19	...	...	...	...	...	104 90	...	...	...	T. C. Qr.
Total	...	64 60	32 50	...	67 90	165 00	104 90	269 90	22 49	1 09	Yield per acre 20 10 1

The methods hitherto recommended, will be found tabulated on Table V together with the name of the author recommending them; this is followed by a brief discussion of each remedy.

No author has hitherto taken the trouble to give estimates of the probable cost of the remedy he recommended, and in many cases no receipt has been given by earlier authors. I have endeavoured to supply these data, and I have tried to get at the actual cost in Trinidad of each spray, or insecticide, and also to find out the cost of application. Finally I have in each case stated my opinion of the value of the prescription. It will be seen that many have to be rejected as useless, or as too expensive, and in one case as too dangerous to human life.

TABLE V.

Table of Remedies,—their Authors and Dates.

Lime	Hart 1890	Collens 1906	Collens 1908	Collens 1909	...	...	...	...	Sir D. Morris in Honduras 1882.—Useless against froghoppers.
Lime Wash	Collens 1906a	...	...	...	...	...	...	...	Collens (1906b) rejects—useless.
Lime and Sulphur Wash ...	Caracciolo 1908	...	...	...	...	...	...	...	Has to be applied warm, and damages foliage—impractical.
Soot	Hart 1890	...	...	...	...	...	...	...	No available supply.
Wood ashes	Hart 1890	...	...	...	...	...	...	...	No available supply.
Paraffin emulsion	Hart 1890	Collens 1906	Collens 1909	Urich 1910	Gough 1910	...	...	...	Effective if properly applied.
Rosin Wash	Barrett ...	Caracciolo 1908	...	...	...	...	...	...	Effective if properly applied.
Cyanide Solution	Urich 1910	...	...	...	...	...	...	...	Effective but too dangerous.
Copper Sulphate	Collens 1906	...	...	...	...	...	...	...	Not sufficiently effective.
Trap lights	Collens 1906	Barrett 1907	Collens 1908	Collens 1909	Urich 1909	Hart 1909	Urich 1910	...	Only catches males.
Catching mature insects ...	Collens 1906a	...	...	...	...	...	...	...	No method indicated.
Burning trash after crop ...	Hart 1890	McLeod 1908	Caracciolo 1908	Hart 1909	Urich 1909	Urich 1910	Urich 1910	Gough 1910	Recommended.
Fallowing	McLeod 1908	...	...	...	...	...	...	...	Unnecessary.
Change of crop	Barrett 1907	...	...	...	...	...	...	...	Unnecessary.
Destruction of diseased canes	Collens 1906	Collens 1909	...	...	...	...	...	...	Unnecessary and undesirable.
Ploughing	Urich 1909	...	...	...	...	...	...	...	Unnecessary.
Weeding and burning weeds	Collens 1906	Urich 1909	Urich 1910a	Urich 1910c	...	...	...	...	Desirable if possible.
Trashing and burning or destroying trash.	Urich 1910a	Urich 1910c	Gough 1910	...	...	...	...	...	Recommended
Moulding up stools ...	Collens 1908	Collens 1909	...	...	...	...	...	...	Unnecessary.
Draining...	Collens 1906	Collens 1909	...	...	...	...	...	...	Sir D. Morris in Honduras in 1882. Unnecessary here
Cover crops on ploughed abandoned fields.	Urich 1910	...	...	...	...	...	...	...	Desirable.
Spreading froghopper fungus	Collens 1906	Hart 1909	Urich 1910	Rorer 1910a	Gough 1910	Gough 1910	Rorer 1910b	Gough 1910	Strongly recommended.
Bird protection	Collens 1908	Urich 1909	Gough 1910	...	...	...	...	...	Recommended.
Stamping out nymphs ...	Black ...	(published	here for the	first time).	...	...	...	...	Recommended.

Quicklime.

The first remedy advocated against the froghopper was quicklime, recommended by Sir DANIEL MORRIS in 1882 in British Honduras, where froghopper blight was severe at Seven Hills Sugar Estate.

In Trinidad it has been recommended by HART (1890) and COLLENS (1906, 1908, 1909).

GILBERT (1908) reports having experimented with lime, using 8 cwt. and 1 ton per acre. It had no effect.

The lime was applied as a surface dressing with the object of killing the nymphs. Its action is retarded by the froth covering the nymphs. Unslaked lime would probably be much more effective, but air-slaked lime is what has in each case been applied. The unslaked lime would require to be previously pulverised, which again would cause it to slake too rapidly, probably already before application.

Carbonate of lime in a dry state is known to be an effective means of killing slugs, snails and the larvæ of some insects, mixed with water its powers as insecticide are to a great extent lost. It does not seem to act through the coating of froth surrounding froghopper nymphs.

The cost of quicklime in Port-of-Spain, Trinidad, is $4.00 a ton, the cost of application will vary according to the amount of lime to be applied per acre from $1 for 2 tons upwards. In addition there will be freight on the railway, which will vary according to the distance from Port-of-Spain. At Couva 80 cents a ton has to be paid for freight.

Cost of application of (quick?) lime, 1 ton per acre:

To lime	... $4.00
„ freight	... 3.20
„ labour	.. 60
Total cost	... $7.80

Although the application of greater quantities would not only do no harm, but also increase the probability of killing the insects, the cost would in any case be excessive.

Lime as an insecticide for froghopper nymphs is ineffective, and too expensive.

Lime Wash.

Lime wash was recommended by COLLENS in 1906, no formula was given.

The usual formula for lime-wash is ;—

Lime ½ to 2 pecks, water 40 gallons.

The quantity to apply per acre is not given by COLLENS.

However COLLENS (1906 b) admits lime wash is of no use as insecticide for froghopper nymphs. This agrees perfectly with the experience of other observers concerning lime wash as an insecticide. LODEMAN (1909) states of lime wash "its effect is but slight."

(*N.B.*—Lime-wash as insecticide is used with success against fowl-ticks).

Lime and Sulphur Wash.

CARACCIOLO (1908) recommended lime and sulphur wash, and gives the formula

Lime	... 20 lbs.
Sulphur	.. 14 „
Salt	... 10 „

The sulphur is added to the slaking lime and boiled for 45 minutes. The mixture is then strained into the pump barrel and applied.

Caracciolo forgets to mention the addition of water.

Lodeman (1910) p. 158 gives the receipt as follows :—

" Lime (unslaked)		...	....	25—40 lbs.
Salt ...	...	...	...	15 „
Sulphur	...	....	...	20 „
Water	...	...	..	60 gallons.

To mix the above take 10 lbs. of lime, 20 lbs. of sulphur and 20 gallons of water. Boil until the sulphur is thoroughly dissolved. Take the remainder—15 lbs. of lime, 15 lbs. of salt—slake and add enough water to make the whole 60 gallons. Strain, and spray on the trees when milk warm or somewhat warmer. This can be applied when the foliage is off the tree, and will have no injurious effects on the fruit, buds or on the tree itself."

Price in Trinidad—

Lime	... 40 lbs. ...	...	... $0.07
Salt	... 15 „ ...	...	... 0.13
Sulphur	... 20 „ ...	...	... 0.25½
Boiling water	... 60 gallons	...	... 30
Labour	... ...	...	... 15
Total price of about 67½ gallons		...	... $0.90½
Price of one gallon per acre ...		...	... 1⅓

Using 40 gallons per acre—

Price of Wash ...	...	...	... $0.53⅓
Labour ...	...	...	... 1.00
Price per acre ...	...	...	... $1.53⅓

This wash is probably of no use, because it ought to be applied warm, and also because of the danger of scorching the foliage. Caracciolo does not mention whether he would have it applied against the nymphs or against the adults, though he probably intended it to be used against nymphs.

Soot.

Soot was recommended by Hart in 1890. There is little doubt that soot would be quite effective in killing all nymphs it came in contact with, and that it could be used with success on a small scale. The supply is however so limited, that it could never be used on a large scale.

Woodashes.

Wood ashes were recommended by Hart in 1890. The same objections apply to woodashes as to soot. Woodashes, made to order, would certainly be too expensive to use even on a small scale.

The ashes from the furnaces of the factory are used as fertiliser, and are extremely valuable as manure, but the supply is very limited.

Kerosene Emulsion.

Kerosene or paraffin emulsion was recommended against froghoppers by Hart (1890) Collens (1906) Urich (1910) Gough (1910).

Hart does not give any formula for making the emulsion, and does not specify further whether it is to be applied against the nymphs or adults, or both.

Collens (1906 *b*) recommended kerosene emulsion to kill the nymphs, but gives no formula. In 1909 Collens gives formulæ for kerosene emulsions (kerosene-hard soap and (Hubbard-Riley) kerosene-Lysol (Carmody)), but does not recommend its use under the column "Remedial Treatment" opposite the froghopper.

Urich (1910 *a*) recommends the same two kerosene emulsions, and gives the formulæ, advocating spraying at 3 week intervals against nymphs, but gives no estimates.

Gough (1910) recommends spraying with the Hubbard-Riley hardsoap emulsion to destroy the adults.

The kerosene emulsions made according to either formula are quite effective if properly applied, and if used sufficiently diluted, will not damage the canes.

The formula of the Hubbard-Riley kerosene emulsion is:—

Hardsoap	½ lb.
Kerosene	2 gallons.
Boiling soft water	1 gallon.

Boil the soap in the water until quite dissolved, pour the boiling soap water into the tank of a bucket spray pump, add the kerosene, and pump the fluid through a fairly fine nozzle back into the tank, (making the fluid circulate through the pump, and the nozzle back into the retainer). The above quantity forms a perfect creamy emulsion in two minutes, if manipulated whilst very hot. The resulting emulsion keeps fairly well, I have been able to keep it for a whole week without change. For use it must be diluted with 8 to 10 parts of soft water.

Note.—The emulsion should be diluted to the required strength, before pouring into the spray pumps, care being taken to mix thoroughly, otherwise harm can ensue to the cane leaves; used in the right strength it will have no harmful effects for the canes.

Cost of manufacture—

3¼ lbs. Soap	... $0.16
13¼ gals. Kerosene	... 4.05
6¾ ,, Boiling Water	... 0.07
Labour	... 0.15
Water to 200 gallons	...
Total	...$4 43
Price of one gallon	...$0 02

The formula for Carmody's Kerosene-lysol emulsion is:—

Kerosene	... 6 parts.
Lysol	... 2 ,,
Water	...100 ,,

Mix the kerosene with the lysol by stirring well, then add to the water.

The Kerosene-Lysol mixture (without water) will remain perfectly stable for indefinite periods. The finished emulsion is stated to keep well.

Cost of manufacture—

Crude Lysol	... 2 galls....	$2.82
Kerosene	... 6 ,, ...	1.80
Labour	... ...	0.15
Water	...100 galls....	
Total	...108 galls....	$4.77
Cost of 1 gallon	... ...	$0.04⅓

Any attempt to control the froghopper by means of sprays must be limited to fighting the adults or flying froghoppers. No spray can be of real use against the nymphs, as they are too well protected by their froth, or are underground and inaccessible. The position of the eggs, embedded firmly in the trash makes them also hard to deal with satisfactorily.

I find the best method of applying the spray to kill the adults is by pouring the fluid into the top leaves of the canes until it commences to overflow out of the angles of the leaves; as the froghopper almost invariably sits in the angles of the topmost leaves a very large proportion, if not all will be killed in this way. After filling the angle of the top leaves, the fluid flows out between the leaf-sheaths into the angles of each successive leaf, killing wherever it comes in contact with an insect. As the fluid remains in contact with the leaves for a long time, it is possible that merely mechanically mixed kerosene and water would separate and burn the foliage if applied in this manner as too strong kerosene emulsion certainly does. It is of no use to apply kerosene-soap emulsion in the form of a very fine spray, as it only kills if the froghopper becomes thoroughly wetted or immersed. Application in the form of a fine spray results in a great waste of labour and material, and only kills a small number of the insects.

The proper time of the year to spray will be in the early season, from April to August. As soon as froghoppers are observed in a field, the spray should be applied there. By this means it should be possible to keep down or greatly reduce the early swarms, and thereby to prevent a great deal of the damage done by the later generations. As the females rarely fly to any distance and as their life is usually spent within an area of a few square yards, each successive generation of froghoppers on any cane-stool contains an increasing number of individuals, because all the eggs of almost all the females of each succeeding generation are laid in a small radius of each other. The sedentary habits of the females explain why so few females are caught by traplights, and also why one so frequently finds badly damaged fields in abrupt proximity to fields where the froghopper is either absent or rare. After August the canes will probably be too high and too dense to permit spraying operations, though where possible, they would still be useful.

An experiment was made to estimate the total cost of spraying an acre; the canes were plant-canes and stood 6 ft. high. Canes not standing so high will probably require less fluid, and also less labour, and will be proportionately cheaper, and *vice versa*.

The application should be made by means of knapsack spray pumps, preferably of a pattern in which the fluid is forced out of the container by compressed air. I have experimented with a Holder pneumatic spray pump, made by Gebruder Holder, Metzlingen, Wurtemberg, Germany, which gives excellent results, being easy to manage and eminently suitable for use amongst the canes. The price of one of these pumps in Germany is $17.60. A knapsack spray pump highly recommended by the Cocoa planters and by Mr. URICH is made by Besnard, Maris and Antoine, 60, Boulevard Beaumarchais, Paris. It is called the "Stoppeur" and has the advantage that the air-pressure has not to be renewed at each charging as is the case with the "Holder" pump. It is sold in sets consisting of a variable number of knapsack-reservoirs and a charging pump. The set usually used here consists of six containers and one pump. The price in France of the pump and a tripod is $24.60, that of a single container about $7.68. A similar apparatus is sold by Ph. Mayfarth & Co. 81, Bunhill Row, London, E.C., under the name "Syphonia," it consists as does the "Stoppeur" of knapsack containers and a separate charging pump, and is probably equally as good as either of the others.

The proper nozzle is a matter of some importance. It is not necessary nor desirable to cause the fluid to leave the nozzle in the form of a fine spray; it is however desirable, when working amongst canes to have a nozzle which enables the operator to work without cutting his hands, this end is attained by making the nozzle a tube of about 2 feet long, and bending the tube at right angles about 2 or 3 inches from the outlet hole, which may measure $\frac{1}{32}$ of an inch in diameter; a tap is necessary, and if the tap is made to open on being pressed and to cut off automatically on. the pressure being released, a great saving of fluid and labour will result A nozzle made at *Brechin Castle* Factory workshop to my specifications embodying the above arrangements gave a saving of at least 30 per cent. on labour and 20 per cent. on fluid This nozzle has a tap which cuts off after passing through an angle of less than 45°; it is closed automatically by a spring, and is prevented from going further than dead shut by bending the trigger so as to surround the pipe. Automatic cut off taps are listed by various makers, but in ordering it should be seen to, that the handle, the nozzle and the tap lie in a straight line, the bend in the nozzle being only at its tip.

In working out the cost of labour, it has been assumed that a gang of sprayers should consist of four men with Holder pumps, a man in charge of a mule with a truck or trolley who would help to charge the pumps and a "driver" to supervise. If more than one gang is working simultaneously the same driver could supervise 2 or 3 gangs, provided they are not working too far apart. A gang working with the Besnard "Stoppeur" pump would consist of six men with knapsack tanks (sprayers), a man to drive the mule and to help to charge the tanks and a driver.

In the experiment with the "Holder" pump it was found that a man can spray at the rate of 1 row a minute (400 rows to the acre) including the time required to recharge and to get up the necessary pressure. One man could consequently do almost 1¼ acres a day, the gang of 4 men spraying should certainly be able to manage 4¾ acres. In my estimate I allow for their doing only 4 acres.

The cost of spraying 4 acres will be:—

160 gallons of fluid	$ 3.90
4 sprayers at 40 cents	1.60
1 mule boy at 45 cents	0.45
1 driver at 50 cents	0.50
	$ 6·45

As chemicals and other substances used for agricultural purposes are allowed to be imported duty free, (or if the duty has already been paid a refund may be obtained) the cost of spraying 4 acres could be reduced to $4 87.

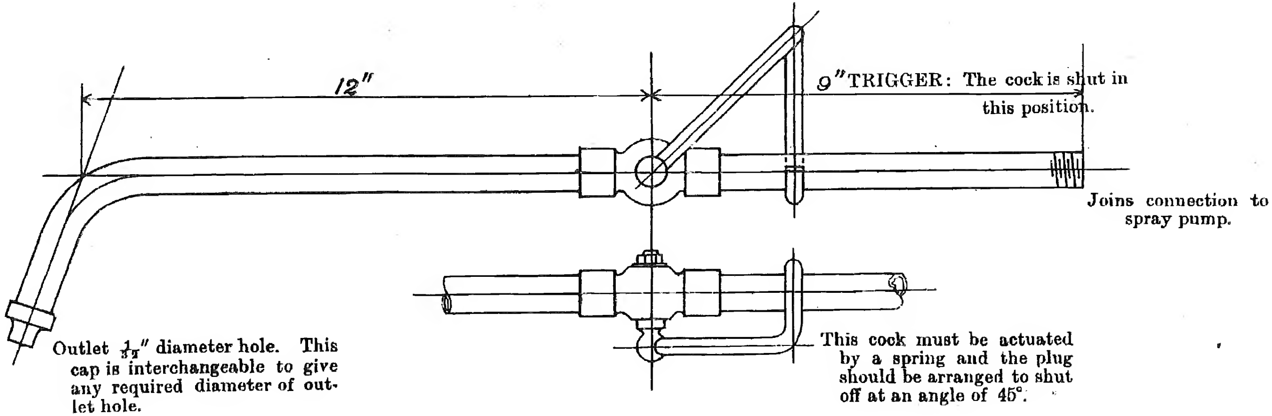
The price per acre would consequently work out at $1.61¼ or $1.21¾ (according to whether duty paid or duty free material is used) or perhaps 25 cents more if we have to make a charge for the use of a mule, which on most estates would only be a book-debt.

Supposing the gang to consist of 6 sprayers, with "Besnard" pumps and assuming that they work at the same rate as was actually found by test with the "Holder" pump, the figures would be .

240 gallons of fluid ...	$ 5.31½ duty paid or	$ 3.35 duty free.
6 sprayers at 40 cents ...	2.40	2.40
1 mule boy at 45 cents ...	0.45	0.45
1 driver at 50 cents ...	0.50	0.50
	$ 8.66½	$ 6.70

or $1.44½ duty paid and $1.11⅔ duty free per acre.

Capital outlay and depreciation of the pumps have not been considered in the above estimates.



NOZZLE TO SPRAY PUMP.

The duty-free price is the one which will be correct to go by, and might be reduced still more by importing the kerosene directly and thus avoiding the agent's charges.

The actual figures will probably be still less, when the work is being done regularly; as increasing skill will lead to avoidance of waste of fluid, and also to quicker work. In addition, half a day's work has been reckoned for making every 200 gallons of the fluid, and in reality it will be found that it does not take more labour to make 400 gallons than to make 200 gallons.

It will be seen that two sprayings hardly exceed the price of one weeding, with the difference that spraying need only be performed in infested parts of the estate. A single spraying over an acre only costs about half the price of a ton of cane, (farmer's canes were bought last year at *Brechin Castle* for $2.28) and thus would already be profitable if it only saves a single ton of cane per acre.

With Lysol Emulsion the cost of spraying would be, using Holder pumps—

160 gallons of fluid	$ 7.66½
4 sprayers at 40 cents	1.60
1 Mule boy at 45 cents	0.45
1 Driver	0.50
Cost of spraying 4 acres	$10.21½

Cost of spraying 1 acre $2 55—duty free proportionately less.

Using Besnard pumps—

240 gallons of fluid	$10.59½
6 sprayers at 40 cents	2.40
1 Mule boy at 45 cents	0.45
1 Driver at 50 cents	0.50
Cost of spraying 6 acres	$13.94½

Cost of spraying 1 acre $2.32½ or duty free proportionately less.

Rosin Wash.

Rosin Wash was first recommended against the froghopper by Barrett (1907 c. f. Arbuckle 1908), afterwards by Caracciolo (1908).

Caracciolo gives the following formula—

Crushed rosin	40 lbs.
Washing Soda	30 „

"or any multiples thereof. Mix well in a cauldron, and add sufficient water to just cover the mixture by a couple of inches, boil slowly, stirring frequently, and if well made the mixture will have the appearance of soft soap."

"To every 50 gallons of preferably soft or rain water use from 10 to 12 lbs. of the stuff mix thoroughly and churn frequently while spraying, spray liberally, drenching the ground. From what I have learnt of the affected areas I should say that pump sprayers on wheels will have to be imported.* I should say that a very good time to spray would be when

* Note.—In my opinion it would be impossible to use a spray pump on wheels in a cane-field. The only suitable spray pumps for use in cane-fields are knapsack pumps.

the ground is clear immediately after the crop is taken off, if the liquid is to penetrate into the ground. .... As soon as the froghoppers appear, spraying should again be undertaken.

PRICES IN TRINIDAD.

Rosin 40 lbs. ...	... ...	$2.40
Soda 30 „ ...	... ...	0.22¼
Water 350 gals.		
Labour and fuel ...	... ...	0.20
Total price	... ...	$2.82¼
Price per gallon	... ...	0.00¾ (approximate.)

Taking the price of application to be the same as for kerosene emulsion, the price of the application will be :

Rosin Wash—40 gallons	... ...	$0 28¼
Labour	... ...	1 00
Total per acre	... ...	$1 28¼

However, more than 40 gallons would be required to "thoroughly drench" the ground over an acre, quite 100 gallons would be required.

The rosin wash might be used to kill the adults, if applied in the manner I advocate for Kerosene-emulsion.

Rosin Wash was tried without result at Brechin Castle in 1907.

Cyanide of Potash.

Cyanide of Potash 1 oz. to 1 gallon of water, was recommended by URICH (1910 a) as a spray to kill the nymphs.

The quantity per acre is not given.

Price : Cyanide of Potash per lb. ... $0.36–$0.40

Taking the estimate for labour for spraying as given for Kerosene solution, and the same quantities, the price per acre will work out at.

Cyanide solution for 1 acre...	...	... $0.90
Labour	... ...	... 1.00
Price per acre	... ...	... $1.90

Cyanide solution is said to be quite effective, and probably does all that is required. There is however, an almost insuperable objection to its use, it is too dangerous a poison to entrust to coolies or negroes. From this cause alone it is very improbable that it will ever come extensively into use. In my opinion it cannot be recommended on account of the grave risks incurred and its use as spray ought to be made illegal.

Copper Sulphate.

2½ % Copper Sulphate solution was recommended by COLLENS 1906 for killing the nymphs.

An effect on the nymphs is hardly to be expected, as copper sulphate is not of much use as insecticide, its value as a spray is on account of its being a fungicide. A 2½ % per cent. solution of copper sulphate would scorch the leaves wherever it came in contact with them, and would require very careful handling on this account. It would require special copper spray pumps with no iron surfaces for the fluid to come in contact with, or else the copper would be deposited on the iron.

Copper sulphate costs locally $97.28 a ton.

One gallon of 2½ % solution of copper sulphate would cost about 1-5th of a cent.

The remedy does not fail on the score of expense, but on account of being dangerous to the canes and ineffective as insecticide.

Traplights.

Destruction of adult froghoppers by means of traplights was recommended by COLLENS (1906, 1908, 1909), BARRETT (1907), and URICH (1909, 1910 a).

URICH 1910 a, found that about one-third of the entire catch of traplight consisted of females. Unfortunately he does not mention the number of samples examined, nor the number of specimens actually counted.

Table II will be found the result of careful countings through 33 samples, taken at intervals throughout the entire sugar area, comprising over 21,000 individuals. The average percentage of females taken was 1⅓ per cent.; in actual figures 20,972 males and 277 females.

The value of traplights seems to me to be very small, when used in the usual way to kill by means of trays of pitch oil or molasses. In 1910 URICH (1910 c) discontinued recommending traplights, without stating his reasons.

A suggestion to use traplights in connection with the froghopper fungus was made by RORER (1910 b) which will be fund discussed under "Froghopper Fungus."

The traplights usually used are ordinary Hurricane Lamps, stood in trays 2½ feet square by about 2 or 3 inches deep, half filled with water and kerosene oil, or with diluted molasses.

Price of Hurricane Lamps bought by the dozen ...	$0.54 each.
Price of Trays about	0.36

The cost of attendance and maintenance is very small, probably not more than $0.12 a night for 6 Lamps, as the labour is usually not charged, the lamps being entrusted to the watchmen.

Capture of Mature Insects.

The capture of mature insects otherwise than by traplights was recommended by COLLENS in (1906 *a*), but he gives no indication as to how this should be done, nor when. In the early season it might be useful to get froghoppers caught by hand by gangs of children, as it is of greatest importance to destroy the earliest generations. Payment per dozen females would be the correct method of employment.

As against this, the consideration has to be carefully weighed, whether the damage done by the children in their attempts to extract the insects from out of the angles of the leaves would not be more than equivalent to the benefit derived from the destruction of the froghoppers.

Burning of Trash after Crop.

The favourite recommendation has always been burning the trash after crop.

This was recommended by HART (1890, 1909), McLEOD (1908), CARACCIOLO (1908), URICH (1909, 1910), GOUGH (1910), in most cases without definite reasons for doing so.

Burning the trash after crop should certainly kill off practically all the eggs laid by the last generation of froghoppers, which as we now know, are laid in the tissues of the base of the leaf-sheaths. Many of the authors have specially recommended it on account of its cheapness (!).

I have long hesitated before deciding to recommend the wholesale burning of the trash, even with the object of lessening or destroying the next year's crop of froghoppers, on account of the expense incurred by burning, the danger of fire getting out of control and of the impoverishment of the soil by the destruction of the humus.

Burning the trash after the crop is regularly carried out in some other sugar-growing countries, for instance in Louisiana and Demerara, but in each case it appears to be called for by local conditions, in Louisiana it is on account of their winter conditions. In other places the trash is highly valued and is used as a surface mulch—(Barbados, Trinidad).

The chief arguments against burning the trash are:—

(1.) A loss of humus is caused by destruction of the trash.

(2.) Without the surface mulch formed by the decaying trash, weeds grow much faster, and an extra weeding becomes necessary.

(3.) It is argued, that even the manurial value of the ashes is lost, as the ashes are blown away by the winds.

(4.) There is considerable danger of the fire getting out of hand and incalculable damage being done.

(5.) It has frequently been observed that fields which have been burnt after crop have blighted in the next season, from which it is argued that the froghoppers must have escaped destruction in spite of the fire.

(6.) It is further argued, that blighted fields, on which the trash has not been burnt, have not been blighted in the next season, from which it is (falsely) inferred that the trash has nothing to do with the froghopper.

Before further discussion I quite admit arguments 1, 2, 3, and 4 to be correct; consequently, if burning is to be recommended, some means must be found by which the loss of humus, the loss of mulch and the loss of fertilising substances can be cheaply replaced. Argument 4 depends on local conditions.

I suggest, that to lesson the damage shown under 1, 2 and 3, a cover crop might be grown amongst the ratoon canes. This cover crop should have the following characteristics:—

(*a.*) It should be a leguminous plant, to add nitrogen to the soil.

(*b.*) It should not grow to more than 2 feet high.

(*c.*) It must not climb.

(*d.*) It must cover the ground well, preventing the growth of weeds.

(*e.*) It should be an annual, and be able to be killed by brushing, or die off as the canes grow high.

(*f.*) It should not offer any attraction to the froghopper.

Whilst leaving the selection of a suitable cover-crop to the practical men, I would like to point out that Wooly Pyrol fulfills all six conditions. The other consideration is, can seed in sufficient quantity be obtained.

To 5·I would like to remark, that in cases where a field which has been burnt during crop blights in the following season, the obvious inference is that that field has been re-infected from outside.

I have heard it argued, if a burnt field can be re-infested from outside, why trouble to burn it at all. The reply is obvious. It is to prevent eggs hatching which can produce froghoppers to blight the same or other fields.

A reason for 6 is hard to give, unless one could actually observe and examine for one's self. The wintering eggs may have been killed by various causes, disease (fungoid or bacterial of the eggs) or unfavourable

weather conditions may have killed the eggs; there is finally also a possibility that no eggs were laid on account of the last generation of froghoppers being wiped out by an epidemic, (of froghopper fungus for instance.)

The actual expenditure to the planter caused by burning the trash can be reckoned at over $4 per acre, made up in the following way. There is a loss of humus and manurial value which cannot readily be expressed in £. s. d., and in addition an extra weeding early in the season, and the extra weeding is inconvenient quite apart from the question of cost, on account of the chronic shortage of labour.

Should it be found possible to grow a suitable cover-crop between the ratoons, a good many of the objections to burning the trash would be done away with. Supposing all my conditions a—f are fulfilled, the loss to the soil due to the burning would be replaced by the cover-crop, weeding would be unnecessary and a saving of anything from 4 to 8 dollars, on weeding alone might be expected, after paying for the cost of sowing.

Fallowing.

Fallowing the land was recommended by McLeod in 1903, but has been recognised as unnecessary and is not practised by anyone. It would cause a considerable loss of revenue if carried out, and yet have no compensating advantages.

Change of Crop.

Barrett recommended change of crop in 1907, the recommendation has found very little favour in the eyes of the planters, and on the information now available appears unnecessary and undesirable.

Destruction of diseased Canes.

The destruction of diseased canes was recommended by Collens in 1906 and 1909. There appears to me to be no reason to destroy cane-stools that have been attacked by the froghopper, especially as they are known to ratoon well, in some cases even better than normally.

Destruction of blighted canes involves considerable loss of capital for replanting and for supplies, without compensating advantages.

Ploughing,

Ploughing was recommended by Urich in 1909. It means replanting and is rather unnecessary.

Weeding and destroying the weeds.

Clean cultivation has been advocated by Collens (1906) and Urich (1909, 1910 a, 1910 c.)

Whilst fully admitting that clean cultivation would probably be of considerable use in checking the ravages, not only of the froghoppers, but also of other insect and fungoid pests, and in conserving the food supplies in the soil for the canes themselves, the practical view of the possibility of clean cultivation must not be lost sight of.

Cane production ceases to be profitable when the cost of a ton of canes produced exceeds $2.50. Clean cultivation would certainly add largely to the present cost if it were attempted, and would almost certainly make cane-growing unprofitable.

Apart from the question of cost, clean cultivation is impossible on account of the scarcity of labour. There is not a cane-planter who would

not attempt clean cultivation without having it recommended to him as a cure for froghoppers or for any other pest, if he had the labour and the money to do it with.

There are at present no figures available to show how much clean cultivation would increase the cost of production. The cost of weeding is about $4 an acre in the early season, decreasing to about $3 later on; to this an additional $2 to $2.50 would have to be added if it is desired to remove the weeds from the fields. Their destruction by fire has been recommended, which at certain seasons would be impossible. Removal of the weeds further means a loss of fertility to the soil, which would require to be replaced in some other way.

Trashing growing canes and burning or otherwise destroying the eggs contained in the trash.

The necessity to destroy froghopper eggs in the trash of growing canes has been recognised since the discovery of the eggs in the trash, and has been recommended by Urich (1910 a & c) and Gough (1910).

Trashing the canes is one of the operations normally carried out in the cane-fields. The dead leaves and their leaf-sheaths are stripped off the canes, and are thrown down between the cane-rows. The work is unpleasant, as it cuts the operators' hands more or less severely. It is almost impossible to get free labourers to do it, and the operation is consequently always carried out by indentured workmen. The cost of trashing an acre, on the above lines, amounts to $2 an acre, the cost of hauling the trash out of the fields has been found at Brechin Castle to be $2.30 an acre.

The disposal of the trash is an important question. Leaving it in the field between the rows is not doing anything to exterminate the froghopper. Removing it is to impoverish the soil, and yet under certain circumstances this seems to be the lesser evil. Various means have been recommended to destroy the eggs in the trash. Urich (1910 c) suggests burning, which I agree to as a last resource. A certain amount might be rendered harmless by using as litter in mule and cattle pens. There the eggs would either be killed by being tramped on, or poisoned by the urine of the animals and by the fermentation which the manure is undergoing, and if any did hatch, they would certainly starve to death before the litter is used as manure. As a considerable quantity of trash is used every day for litter, it would probably cost very little extra to haul it from fields which require treatment instead of from normally healthy fields.

I now consider it questionable, whether the trash could be economically treated with lime, or insecticides.

Moulding up of stools.

Collens (1906) recommended moulding up affected stools, in order to suffocate the nymphs, and to encourage root-growth. The cost would be about $4.00 an acre, the result to be expected practically nil, as froghopper nymphs are quite capable of living underground.

Draining.

In 1906 Collens recommended draining. In those days the physical and chemical condition of the soil was considered to have much to do with the blight.

In my opinion the cane estates are quite sufficiently drained, and the drains or their absence has very little to do with the froghopper. In Tobago, where drains do not exist in the cane-fields, the froghopper occurs, but in such small numbers that it can do no damage.

On some estates in Trinidad there seems to be some difficulty about the main-drains, especially when the main-drains have to cross estates belonging to other proprietors or Crown lands in order to reach the sea. There appears to be no legislation (?) or no working arrangement, by which such drains can be constructed when necessary, nor by which they can be maintained by those interested in them, still less can the proprietor over whose estate such drains run be compelled to keep them in order. In a country with the high average annual rainfall of Trinidad, drains are more of a necessity than elsewhere, and the absence of some provision for their construction and maintenance across estates bounding the sea for the benefit of the inland proprietors is rather a misfortune.

The cost of draining averages in some places about $0.20 a hundred feet for drains (20 inches wide at the top, 18 inches at the bottom, and 12 to 15 inches deep) and 10 to 15 cents for cleaning old drains, in other places just double these figures must be reckoned. Main-drains or ravines as they are locally called vary considerably in depth, and consequently in cost.

Stamping out Nymphs.

Mr. Black of Waterloo estate employs apparently with considerable success the method of killing the nymphs by stamping on them. The work is performed by children armed with poles or clubs, who smash up every mass of froth (and consequently all the nymphs) which can be seen at the roots of the canes. Nymphs living further underground escape.

The cost is said to be $0.80 an acre, and is well repaid by the results. The method is most successful if carried out after a weeding.

Cover Crops.

Urich 1910 advocates cover crops on abandoned fields.

The question of planting cover crops on abandoned fields, and between plant canes has long since been taken up and experimented on by the planters, with varying success.

Where the land has been steam-ploughed Bengal Black Beans have proved a great sucess on abandoned fields, as for instance at Caroni in 1910. The same bean has however sometimes failed entirely where sown without previous preparation of the soil, as at Chaguanas in 1910.

No field that is not going to be cultivated with sugar-cane, should be abandoned and left to itself in the way that usually happens. Such abandoned fields are a perfect nursery for froghoppers and other insect and fungoid pests, and the wisdom of utilising them as a source from which to obtain plant canes is at least very doubtful. It is surely better to grow one's supply of plants in a nursery, and to utilise the best and most vigorous canes to cut one's plants from, rather than take them from the old and impoverished canes one finds in abandoned fields. The use of abandoned fields as nurseries for plant canes cannot be too seriously discouraged.

Putting an "abandoned" field under a cover crop is introducing a rotation of crops, and needs no further recommendation.

The cover crops tried hitherto includes Black-beans, Cow-peas, Soy-beans, &c.

Utilisation of the Froghopper Fungus.

Collens (1906) first suggested utilising the froghopper fungus, but gave no intimation as to how to do so, Hart (1909) likewise.

In 1910 Urich and Rorer started experimenting with the artificial cultivation and spreading of the fungus, simultaneously but independently with myself. It has now been shown that (1) it can be grown in the necessary quantities, (2) it can be spread artificially.

I have found it possible to spread the infection artificially in a field where the fungus was not present before the experiments were commenced. Two methods proved successful, (A) spraying the spores by means of a powder-bellows set up a slight infection, (B) exposing small cultures in the angles of the cane leaves produced a fairly severe epidemic amongst the froghoppers.

(A.) The fungus was grown on a large scale on potato; the spores were scraped off the cultures, mixed with a large quantity of flour and dusted on to the canes by means of a powder-bellows.

The object of the flour was to increase the bulk and to indicate the area infected. Enough spores were added to one pound of flour to turn the mixture grey, this quantity was sufficient for $\frac{1}{20}$ acre. The effect of the dusting is lost after the first shower of rain, and is obviously only of short duration. The results do not justify the trouble or expense. The same remarks will apply to any method by which spores are blown or dusted over the canes.

(B.) The fungus was grown on a large scale on very small chips of potato, on peas or on rice. After growing for 14 days in the laboratory, the cultures were distributed in the field. A single potato-chip or rice-grain on which the fungus was growing was placed in the angle of the topmost leaves of the canes.

Potato-chips and rice grains exposed in this manner have been found to be still covered with the fungus after 3 weeks' exposure. The amount of culture required for this method is not more than is needed for dusting. The method is a direct imitation of Nature, the grains of culture taking the place of infected froghoppers. The method has proved to be quite successful.

A further method of spreading the infection has been suggested by Rorer (1910 b.) which, although hitherto untried, ought to give good results. Rorer writes:—

"Another method by which a green muscardine epidemic might be brought about is by catching the insects at night with lights, as many as 5,000 have been caught with a single lantern in a night, inoculating them and setting them free in the morning. A large percentage of these insects would contract the disease and die within a few days. The fungus would begin to fruit on the dead bodies and the spores in turn would serve as a source of infection to others, for as previously stated the insects usually die attached to the basal parts of the leaves, the favourite hiding place for the insects in the day time. If a systematic campaign of this kind were started just after crop time on an estate there is no doubt in the writer's mind but that the froghoppers could be kept under control."

Rorer's traplight method ought to yield very good results in fields where the froghopper has already become common, exposure of cultures, method B, would be advisable at any time, and should also work successfully when the insects have not yet become too abundant.

In recommending the traplight method, I suggest an alteration in the procedure which should at once simplify and cheapen it. Instead of catching the froghoppers, inoculating them and setting them free next morning, I would recommend that the traplight be placed in a tray containing cultures on large pieces of potato. A small roof should cover the lamp and tray, to prevent the cultures being spoilt by rain. Such cultures, on half pieces of potatoes, if reasonably carefully treated, should remain in good condition for at least one month. The froghoppers would infect themselves by settling on or touching the cultures in passing to the lamp. There is really no reason for handling them at all.

The Cultivation of the Fungus.

The Apparatus :

For the cultivation of the Froghopper fungus on a large scale the following apparatus is necessary:—

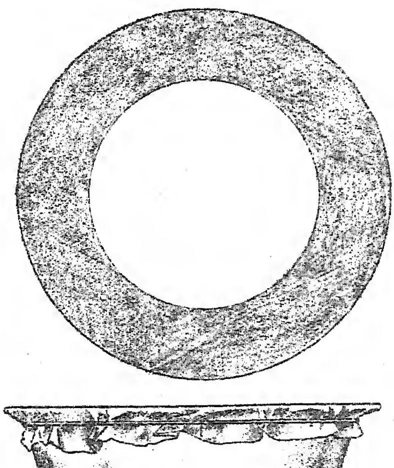
(1.) A steam-steriliser.
(2.) Culture-dishes.
(3.) A platinum wire with glass-handle for inoculating.
(4.) A supply of test-tubes and cotton wool.

A pure culture of the froghopper-fungus is also required as a stock from which to inoculate the required cultures. This can be obtained on application to the Director of the Department of Agriculture, with whom I am depositing a supply.

The steam-steriliser can be built from the plans given on figure A. It can be described as a cylinder of tin, with a perforated false bottom 4 inches from the bottom, and stands on 3 legs. A funnel at the side serves as gauge for the water-level and to fill the boiler. The lid is conical, with an aperture to pass a thermometer through, or for the steam to escape. The steriliser can be constructed of strong tin, its sides and lid should be covered with a sheet of asbestos or some similar substance to conserve the heat, the bottom alone being exposed. A "primus" stove serves to heat the apparatus.

The whole apparatus can be built for a few dollars. The cylinder can be made up out of old oil-drums, the funnel and lid of pitch-oil tins. The whole steriliser can be readily constructed in a factory workshop.

The culture dishes require to have as big and flat a surface as possible. They can be made of tin (pitch-oil tins can be utilised in their manufacture). The dishes are circular and are used in pairs, one of the pair being about 1 inch less in diameter than the other, the smaller having sides 2 inches high, the sides of the larger one being only 1 inch high. For use in the apparatus whose dimensions are given in the figure, the larger dish should not measure more than 12 inches in diameter, the smaller one being correspondingly smaller. It will be necessary to have a large number of pairs of dishes made. About 10 can be sterilised in the apparatus at one time.



Reduced to ¼ of original size

A Culture dish made out of a tin pudding-dish and a glass circle

A more satisfactory culture-dish can be made out of a tin pudding dish. These dishes are sold at a very cheap rate in the larger shops at Port-of-Spain. They have the advantage, being stamped out of one piece of tin, of having no joins where dirt can collect. They are made in various sizes, I use some whose top diameter is 8 inches, and whose bottom diameter is 7 inches, they are about 2 inches deep. Around the edge of the top of the dish is a horizontal flange ¼ of an inch wide. As lid I use glass circles, cut to the exact diameter of the outer measurement of the flange, (for dishes 8 inches in diameter the diameter of the glass circle is also 8 inches).

The lid is fixed and held firm to the dish by two layers of brown paper which are tied tight by means of a string passed round the under surface of the flange.

There is absolutely no difficulty in getting these dishes sterile or of obtaining pure cultures in them.

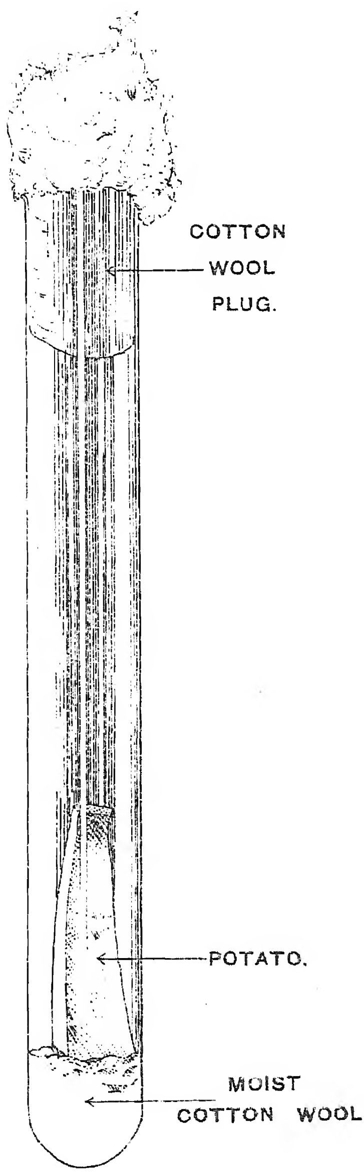
The inoculating needle consists of a thin platinum wire about 3 inches long fitted in a glass-rod a few inches long.

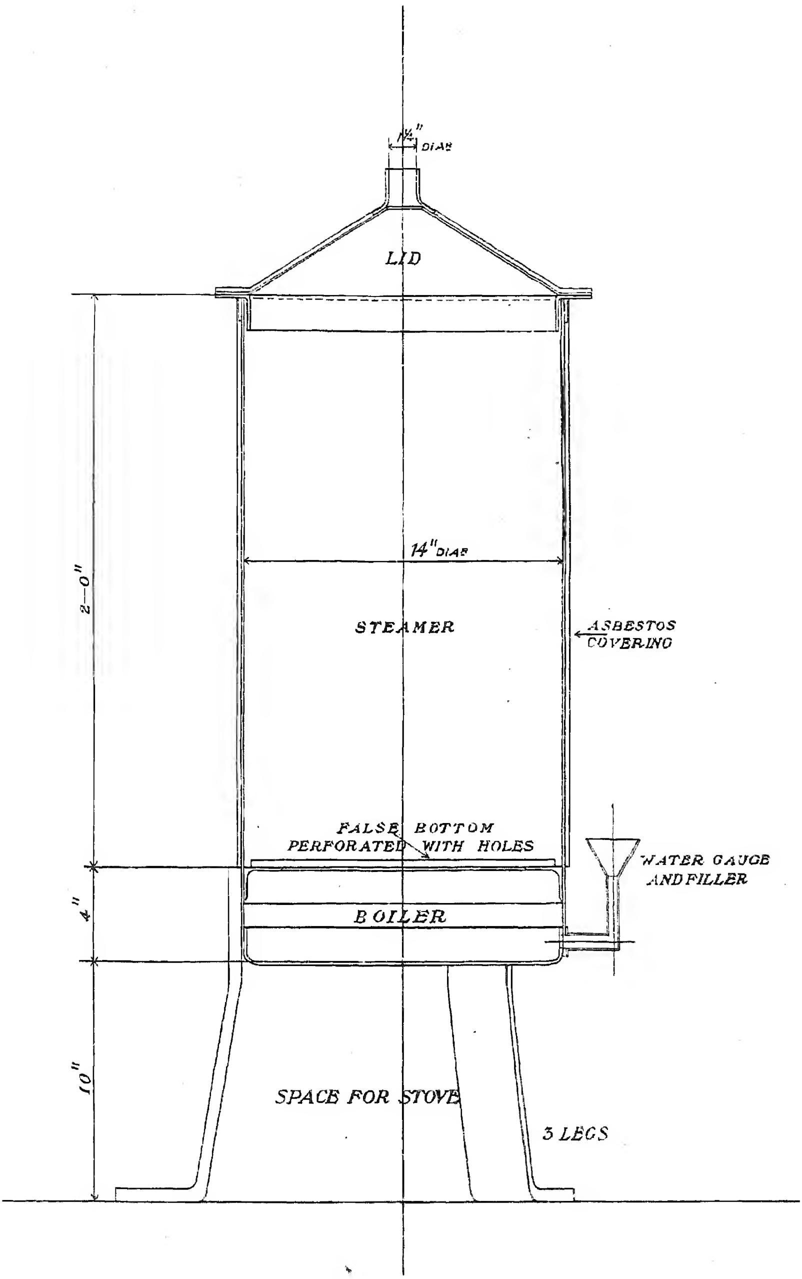
PREPARING CULTURE MEDIA.

Culture media will have to be prepared for two purposes: to keep up a stock culture and to grow cultures on a large scale.

The stock cultures are best grown on slices of potato in test-tubes. Test-tubes 6 inches by ¾ inch are to be recommended for this purpose.

In preparing potato-tubes I always first ram a wad of cotton-wool into the bottom of the tube. This wad serves as a reservoir for moisture. The tube is then filled with water and allowed to stand for a few minutes, until the cotton-wool has absorbed all the water it can, then it is inverted and the surplus water is drained out. Wedges of potato about 2 or 3 inches long, by ½ inch broad are cut, so as to be about ½ inch thick at the bottom and quite thin at the top. These are allowed to soak in cold water for half an hour, and are then inserted in the tubes, with their thick end down towards the cotton-wool. Soaking the potato before placing in the tube is necessary to prevent discoloration after sterilising. The tubes are now ready to be plugged. The plugs are made of absorbent cotton-wool, and should enter the tube for 1 to 1½ inches, a fair-sized wad should project from the tube to enable the operator to remove and replace the wad when inoculating the tube or when it is required to remove spores from the culture. The wads are best made by tearing off pieces of cotton-wool, and ramming them into the neck of the tube with a glass rod, the thin end of a penholder or some similar instrument. The wad should fit tightly, and should be made in such a manner that it does not expand unduly on extraction. When a batch of tubes has been prepared as described, they are ready for sterilising. This is done in the steam-steriliser. Having seen that there is sufficient water in the boiler, the stove is lit and placed under the apparatus. The tubes can be placed in a wire-basket or small tin (I use an empty cigarette-tin), and stood on the false bottom of the steriliser. I find it a good plan to wrap up the whole batch of tubes in brown paper, this prevents the plugs from becoming too damp when sterilising. Having placed the lid on the apparatus, one leaves the tubes in it for a whole hour after the water in the boiler has commenced to boil and has filled the steriliser with steam. They are then removed from the steriliser, taken out of the brown paper wrapper and allowed to stand in the room for twelve to twenty-four hours, when the sterilising is repeated a second time, for a whole hour. After another period of 12 to 24 hours after the second sterilisation they must be sterilised for the third time again for one hour. After cooling they are ready for use. I have occasionally found 24 hours at the temperature of my laboratory too long a period to wait between first and second sterilisations. Sterilising at intervals of 8 hours and 12


COTTON
WOOL
PLUG.
POTATO.
MOIST
COTTON WOOL



STEAM STERILISER

hours has been quite satisfactory. The object of sterilising three times at short intervals is to make certain of killing off all the germs in the media. The first steaming kills off all bacteria and fungi, but not their spores. Leaving the culture media to rest for 12 to 24 hours gives the spores a chance to germinate, they are then readily killed by steaming. The third steaming kills all spores that have been formed between the 1st and 2nd steaming and have germinated, and all such which may have remained dormant from the beginning and have germinated since the second steaming. Three steamings are usually quite sufficient, but not always so. Most spores of bacteria and the spores of many fungi are much more resistant to heat than the bacteria or fungi to which they belong.

The cultures for exposing in the field are best grown on rice. Cover the bottom of the smaller of the two dishes of each pair to about ¾ of its surface with rice that has been well washed previously. Pour in sufficient water just to cover the rice. Tie a string twice round the dishes after putting on the lid so as to have a handle to lift the dishes into and out of the steriliser.

In using "pudding tins" one fills the bottom of the tin with rice in a similar manner, before fastening down the glass lid.

Sterilise 3 times for one hour at 12 to 24 hours interval, the rice is then ready to use. The desideratum is to get the rice boiled with each grain quite firm and separate, and to get the bottom of the pan covered by an even layer of rice. Too wet a medium is to be preferred to too dry, as the fungus requires a rather moist medium to grow on. If preferred the rice might be first boiled, then placed in a single layer in the pan, and then sterilised. The dishes should not be opened between the sterilisations, and afterwards only when inoculating or when examining the stage of growth, and then only with great care. It will be found necessary to stand the dishes in some place where ants cannot get at them, for instance on a tin standing in a plate of kerosene. Should a single ant succeed in entering a dish, the whole of the sterilising would have to be repeated.

Inoculating the culture media.

After sterilising 3 times, the culture media in the test-tubes and in the flat dishes contain no living organisms, and will remain in the same state until germs are introduced from outside. The object in view in inoculating is to introduce spores of the fungus we want to cultivate, and at the same time to prevent any other germs from entering.

In making an inoculation of a test-tube one proceeds as follows. First sterilise the platinum wire and its glass holder for the distance that it will have to enter the test-tube and a little beyond. This is done by drawing the wire and rod slowly through the flame of a spirit lamp (or Bunsen burner where available). The wire should become red-hot, and the heated portion of the rod too hot to hold. After heating the wire should not be allowed to touch anything and should not be touched or laid down until after use. Open the test-tube containing the pure culture it is desired to propagate withdrawing the plug with a screwing motion. Be careful not to touch the portion of the plug which has to re-enter the tube. It will be found a good plan to grip the tube with the left hand, and the plug with the back of the middle and 4th fingers of the right hand. The plug is retained in that position until the next operations are completed. Now heat the mouth of the tube by turning rapidly in the flame. Withdraw the tube from the flame, enter the platinum wire without it touching the tube, and just touch the culture with the tip of the wire. Withdraw the wire, heat the mouth of the tube again and return the plug. In the meanwhile the wire must not be allowed to come in contact with anything. Pick up the tube to be inoculated, remove the plug and heat the mouth as was done with the original culture tube, enter the wire and draw it lightly along one of the surfaces of the potato. Heat the mouth of the tube and re-insert

the plug. All the operations should be done as quickly as possible, away from draft of any kind. A label with date should then be stuck on the tube about 1 inch from its mouth. Finally draw the wire again through the flame to remove and kill any spores remaining on it.

The inner-surface of the plugs must on no account be allowed to touch anything whilst inoculating. Should this however have happened by accident pass the plug through the flame to singe its inner end. Should anything have touched the needle during the operations, preceding the actual inoculation of the new tube it is best to begin again quite from the beginning.

In inoculating the large cultures commence by sterilising the platinum wire in the flame and open the original culture tube in the same way. The needle should however this time be pushed into the green spore mass of the culture in order to charge it with a somewhat greater quantity of spores than is necessary for the test tube culture. It is however not necessary to be able to see any spores on the wire. Having withdrawn the wire and re-stoppered the tube as before, lift the lid of one of the pairs of dishes with the left hand until one edge is about 2 inches above the edge of the bottom tray without however displacing the lid in a horizontal direction. Holding the glass-rod of the platinum wire between thumb and middle-finger, enter the wire between the two dishes and then tap the glass rod gently once or twice with the fore-finger, in order to scatter the spores into the dish, then withdraw the wire and close the dish.

In inoculating "pudding tins" first untie the string, lift up the margin of brown paper around about half the circumference of the lid, then lift the glass lid by pressing the glass laterally with one finger—do not insert the finger under the glass, or else you may infect the culture medium with wild germs—it will not be necessary to lift more than half an inch; insert the inoculating needle and shake off the spores by tapping the handle of the needle; withdraw the needle; replace the paper margin and tie down; a hole can be cut out of the paper covering the glass to admit light to the culture and to facilitate observation.

Having first labelled it, leave the dish now untouched in a place where the ants cannot get at it. In a week's time it will be early enough to inspect how the growth is progressing, and to assure one's self that the culture is pure and has not been contaminated by wild germs during any part of the operations. The culture should be ready for use in 14 days' time; left longer the spores often germinate spontaneously.

In inoculating, the mistake invariably made by beginners is taking too great quantities up with the platinum needle. To start a culture in a test-tube a single spore is quite sufficient. By just touching the culture very lightly with the wire, several scores of spores will be removed; likewise in making the inoculation of the large culture dishes, it is not necessary to remove a visible quantity of spores; by boring the wire into the coating of spores of the original culture and withdrawing, a quantity of spores sufficient for the needs of the dish will certainly be removed.

The cultures can be sent into the field in the dishes they were grown in. A single grain of moulded rice is to be placed in the angles of the top-most leaves of the canes. It is not necessary, although it is desirable, to place one grain on each cane.

Rorer (1910 *b*) gives the following indications of his method of growing the fungus on a large scale.

"In order to get spores in sufficiently large quantities for practical field inoculation some methods other than those in everyday laboratory practice must be used for growing the fungus. The writer has designed

what may be called a culture cabinet in which the fungus has been grown in quantity with almost no impurities. This cabinet may be considered as the unit and an indefinite number may be arranged in series. The cabinet is nothing more or less than a cupboard 6 feet high, 2 feet deep and 3 feet wide, the top, bottom, two sides and the back made of galvanized iron and the joints soldered. The front is a tight fitting door with two glass panes for the admission of light. Eleven galvanized iron shelves are arranged horizontally inside the cabinet at intervals of 6 inches and supported by brackets soldered to the side walls. Sets of two holes each, about half an inch in diameter, are punched through the back of the cabinet midway between the top and the first shelf and each succeeding pair of shelves. These holes are plugged with cotton. The medium used for growing the fungus is boiled rice. The rice should be thoroughly washed and then put into boiling water and cooked for not more than ten minutes. It must not be pasty. This cooking sterilizes the rice and can be done in a large open pan or kettle. As soon as cooked, the rice should be dipped from the water with a perforated ladle or strainer and quickly spread in a thin even layer on all the shelves and bottom of the cabinet. The door is then closed. The heat from the rice in a way sterilizes the whole cabinet. After about two hours, or when the rice has cooled down enough, the inoculation may be made. Spores from one or two pure tube cultures are mixed with an ounce of flour, which has been sterilized in a dry oven, and placed in a clean insect gun or bellows such as is used for blowing pyrethrum powder into cracks and crevices. The cotton plugs are removed from the holes in the back of the cabinet, the end of the bellows tube inserted and the mixture of spores and flour blown into the cabinet through each hole in turn. The cotton plugs are then replaced. The spores germinate quickly in the rice and being present in such large quantities thousands of colonies start all over the surface. Within a few days the whole medium is covered with a dense mycelium. Spore formation soon begins and at the end of three or four weeks the maximum number of spores have been produced. A few colonies of *Sterigmatocystis* or of *Aspergillus* may come up here and there on the shelves but they do no particular harm and cannot gain a foothold, on account of the predominance of *Metarrhizium.*"

The objection to this method is that the media are not sufficiently sterile; rice cooked and spread out on the trays in the manner described, would, if left to itself, soon be covered by "wild" moulds and bacteria. Inoculating by means of spores mixed with flour is again introducing spores of other species of mould, unless the flour is previously sufficiently sterilised, and it would be impossible to sterilise the powder gun sufficiently. These objections would be removed if some method could be found to sterilise the whole cabinet after filling the trays with rice; for instance by leading running steam from a steam pipe through the cabinet, letting it enter at the bottom and escape through a ventilator at the top or by fitting a boiler at the base of the cabinet, and inoculating by introducing spores on a sterilised wire through the plug-holes. Worked in this way, the cabinet would probably be convenient and should give good results.

A steam steriliser and the necessary dishes, or the required number of Rorer cabinets, ought to be able to be made in any factory workshop for a few pounds. The cost of manipulation cannot be estimated before a trial on a larger scale than has yet been attempted has been made. Sterilising can be left to a specially trained coolie, working under supervision. Inoculating should be done by some responsible person. The material used for culture media will cost very little, one pound of rice should be sufficient to supply a grain for nearly every cane in an acre, one pound of potatoes to supply a trap-light with the necessary infecting material.

Bird Protection.

It has been urged by COLLENS (1908) and URICH (1909) that the protection of wild-birds, lizards and toads should be of use.

There is no doubt, that the sugar area has been seriously depleted of its bird life. The mongoose has been responsible for a great part of damage, and although the Government is offering a reward of $0.60 for each female and a less sum for the males, these animals are still far too common. At Caroni the estate pays a further sum of $0.24 for every mongoose killed within its boundaries.

It would be well worth while encouraging birds to breed on the sugar estates. At the present time on almost any estate there are miles and miles of land almost without trees or entirely without trees. As a natural consequence nesting-places have become very rare, and the birds have disappeared. It would go a long way to restocking the sugar area with useful birds, if bird-sanctuaries were erected at intervals of say one mile. The sanctuaries might consist of thickets covering perhaps one, perhaps half or less of an acre. They should be properly fenced, or otherwise protected from invasion by children or people who might disturb the birds or destroy their eggs and nests. If useful timber trees were grown, they would become a source of revenue later on. The bamboo thickets do not appear to be suitable for the requirements of birds, and are probably cut down too frequently.

Bibliography.

The records of the literature concerning the Froghopper Fungus are mostly taken from Rorer (47). Papers referring exclusively to the Froghopper are marked T., those dealing only with its fungus-disease F. Papers not seen are marked *.

1. *Metschnikoff, E.—1879—Title? Zeitschr. d. Kaiserl. Landw. Gesellsch. f. Neurussland. Odessa 1879 pp. 21–50 w. pl. F.

2. *Sorokin, N.—1879—Title? *Ibid.* p. 268. F.

Morris, Sir D.—1883—The Colony of British Honduras, its Resources and prospects p. 35. T.

3. *Metschnikoff, E.—1883—Zur Lehre der Insektenkrankheiten. Zool. Anz. 1883. 3 pp. 44–47. F.

4. *Krassilstchik, J.—1886—De insectorum morbis qui fungis parasiticis efficiuntur. Mem. de la Soc. de Naturalistes de la Nouvelle Russie Odessa, Vol. XI fas 1. pp. 75-172. 1886. F.

5. * Krassilstchik, J.—1888.—La production artificielle des parasites vegetaux pour la destruction des insects nuisables. Rev. gen. d'agric. et de vitic. meridionales 1886 June 5. F.

6. Hart, J.—1890.—Report of Sugar Cane Blight *Agricultural Record*, Trinidad Vol. 11, March, 1890, p. 126. T. F.

7. * Delacroix, G.—1893.—Oospora destructor, champignon produisant sur les insectes la muscardine verte. Bull. Soc. Mycol. de France. 1893 Vol. IX pp. 260–268. pl. XIV. F.

8. Diseases of the Sugar Cane, questions submitted by the Commission instituted by the Governor of Martinique. Proceedings of the Agricultural Society 1894 p. 63 (Possible reference to nymphs of the froghopper.)

9. * Petit, R. H.—1895.—Entomogenous fungi. Bull. 97. Cornell University Expt. Station p. 356. Pl. V. F.

10. Cruger, H.—1902.—Cane Diseases and Pests M.S. dated 1863, published 1902. *Agricultural Record*, Trinidad, October, 1892, p. 78. T.

11. Francis, E. E. A.—1902—On a chemical examination of Blighted Sugar Cane, and of the soil in which they were grown.—M.S. dated 1872. Ibid p. 96. T.

SUGAR.—*Continued.*

12. The small Sugar Cane Borer.—Journ., Field Nat. Club, Trinidad, Vol. 1, 1902, p. 45.—The paper mentions the chief Sugar Cane Pests but omits the froghopper. which was in that year either not common, or more probably not recognised as a pest.

13. *Vuillemin, P.—1904—Les Isaria du genre Penicillium. Bull. Soc. Mycol., France, 1904, Vol. XX., pp. 214–221, pl. XI. F.

14. Fowler, W. W.—1904–1909—Rhynchota. Hemiptera-homoptera. Vol. 11, Part 1., in Biologia Centrali-americana. 1894–1900. T.

15. Collens, A. E.—1906a—Report on Diseased Canes at Harmony Hall and Tarouba Estates. Oct., 1906. T.F.

16. Collens, A. E.—1906b- Result of Inspection of Cane Blight Disease at Brechin Castle Estate. Oct., 1906. T.

17. Hart, J.—1906—Cane Diseases.—Botanical Department Bulletin. Oct., 1906. T.F.

18. Barrett, O. W.—1907a—Blight in the Sugar Canes. Proceedings Agricultural Society, Trinidad 1907, Vol. VII, pp. 251–252. T. F.

19. Barrett, O. W.—1907b—Cacao Pests of Trinidad with Notes upon Miscellaneous Crops. Proceedings Agricultural Society, Trinidad, 1907, Vol. VII, p. 300. T. F.

20. Heriot, T. H.—1908—Contributions towards the study of the Froghopper. T. Proceedings Agricultural Society, Trinidad, 1908, Vol. VIII, p. 549. T.

21. McLeod, J. J.—1908—Paper on Froghopper. *Ibid*, p. 552. T.

22. Fenwick, G. T.—1908—Letter. *Ibid.*, p. 557. T.

23. Caracciolo, H.—1908—Letter. *Ibid.*, p. 558. T.

24. Collens, A. E.—1908—Letter. *Ibid.*, p. 561. T.

25. Black, J.—1908—Letter. *Ibid.*, p. 565. T.

26. Arbuckle, J.—1908—Letter. *Ibid.*, p. 566. T.

27. Gaul, J.—1908—Letter. *Ibid.*, p. 568. T.

28. Gilbert, J.—1908—Letter. *Ibid.*, p. 570. T.

29. Hart, J.—1908—Froghoppers. *Bulletin Miscellaneous Information*, Oct., 1908. T.

30. Collens, A. E.—1909 a. Sugar Pests, summary of symptoms and Treatment. *Bulletin of Agricultural Information*, Trinidad, January and April, 1909, p. 40. T.

31. Collens, A. E.—1909 b—Insects and insect destroying fungi recently identified. *Ibid*, p. 45. T. F. (Identification by Bureau of Entomology, Washington of Tomaspis postica (Walk.) and Oospora destructor and Penicillium anisotliæ).

32. Hart, J.—1909—Remarks on Sugar Cane Blight.—Proceedings Agricultural Society. Trinidad, 1909, Vol. IX., p. 32. T. F.

33. Carmody, P.—1909—Sugar Cane Blight and Analyses of Soils 1909 p. 107. T. F.

34. Urich, A.—1909c—Analysis of a heavy clay soil at Frederick (Caroni estate) badly attacked by Blight in July, 1908.—*Ibid*, p. 114. T.

35. Collens. A. E.—1909c—Report on Diseased Canes at Harmony Hall and Tarouba estates.—Republished from 1906.

36. Collens. A. E.—1909d—Result of Cane Blight Disease at Brechin Castle estate. *Ibid*, p. 121. Republished from 1906. T. F.

37. Urich, F. W.—1910a—Froghoppers. *Ibid*, p. 125. T.

38. Lodeman, E. G.—1909—The spraying of Plants.—London, 1909 (Macmillan & Co.)

39. Urich, F. W.—1910b—Froghoppers in Sugar Cane. Bulletin, Department of Agriculture, Trinidad, Vol. IX, pp. 15–21, April 1910. T. F.

40. Gough, L. H.—1910a—Traplights.—Proceedings Agricultural Society, Trinidad, Aug., 1910, Vol. X, p. 305. T.

41. Gough, L. H.—1910b—Biology of the Froghopper. *Ibid*, p. 361. T. F.

42. Gough, L. H.—1910c—Control of Froghoppers. *Ibid*. p. 366. T. F.

43. Urich, F. W.—1910c—Froghoppers, Froghopper-Fungus and Froghopper control. *Ibid.* p. 368. T. F.

44. Rorer, J. B.—1910a—The Froghopper Fungus. *Ibid.* p. 377. F.

45. Urich, F. W.—1910d—Froghopper control. *Ibid.* p. 380. T.

46. Gough, L. H.—1910d—Results of experiments with the Froghopper Fungus. *Ibid*, p. 463. T. F.

47. Rorer, J. B.—1910b—The Green Muscardine of Froghoppers. *Ibid*, p. 467. F.

48. Urich, F. W.—1911.—Identification of the Sugar Cane Froghopper. *Ibid*, December, 1910, p. 525. T.

49. Gough, L. H.—1911.—On Spraying for Froghoppers.—Trinidad Department of Agriculture, Circular No. 5. T.

50. Gough, L. H.—1911.—The Froghopper Fungus and its practical application—Trinidad Department of Agriculture, Circular No. 6. F.

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January 7th, 1911.

(Agricultural Society Paper No. 442).

The Green Muscardine of Froghoppers.

By James Birch Rorer, Mycologist, Board of Agriculture.

Introduction.

Although blight has been known as a specific disease in Trinidad cane fields for the past 30 years or more and many planters have always maintained that the froghopper (*Tomaspis postica*) was responsible for the trouble, there has been much doubt expressed as to its cause by those who have investigated the outbreaks until within the last year, the uncertainty that has existed being well summed up in the following concluding words of the report of the Chairman of the Committee which was appointed by the Agricultural Society in the latter part of 1908 to collect evidence from cane planters as to the cause of blight, "the primary cause in my opinion being root fungus or boring insects, of unfavourable soil and climatic conditions, or a combination of these, leading to the formation of different kinds of fungi known to attack canes." [20 *]

However, from studies which have been made both in the field and in the laboratory during the past year there seems now to be but little doubt that the froghopper is the cause of blight, and the question of getting rid of blight, has resolved itself into the question of destroying the froghopper, or at least reducing its numbers to a negligible quantity.

Naturally the problem is an entomological one and both Mr. Urich, Entomologist of the Board of Agriculture, and Dr. Gough, who has been sent out by the proprietors, are investigating the disease from that point of view and doubtless they will publish full reports in due time. From the mycological standpoint the only interest in the disease is to ascertain whether or not plants which are attacked by fungus diseases are more subject to the attack of the froghopper, and whether the insect can be controlled by wholesale inoculation with spores of the fungus which causes green muscardine, a disease to which the froghopper is very susceptible.

* The numbers refer to the Bibliography which will be found at the end of this paper.

Since this article was written the Trinidad Froghopper has been named *Tomaspis varia*. *See* page 58.

RELATION OF BLIGHT TO ROOT-DISEASE, LEAF-SPOT AND RED-ROT.

The root-disease of sugar cane was first carefully studied in Java by Wakker[9], and the cause determined to be *Marasmius sacchari*, a small mushroom, the mycelium of which lives on old cane trash, spreads through the soil and at times attacks and destroys the young cane roots, so that the plants remain stunted and the leaves gradually shrivel up. The disease in the West Indies was investigated by Howard[10], who ascribed the trouble to the same fungus. Stockdale[19], from his studies concluded that more than one species of Marasmius was responsible for the West Indian disease. In Hawaii, both Lewton-Brain[12] and Cobb[13] have reported on the root-disease. A variety of *Marasmius sacchari* was described by the former as the cause, but Cobb found that most of the harm was done by *Ithyphallus coralloides*, one of the stink horn fungi. According to Fulton[16] most of the trouble in Louisiana is due to a fungus which in all probabilities is *Marasmius plicatus*, a species originally described by Wakker from canes in Java. In a preliminary report on the cane blight in Trinidad, Barrett[15] stated that he believed *Marasmius sacchari* to be the cause of 90% of the injury. Collens[21] ascribed the matting together of the cane sheaths, a characteristic of root-disease, to the same fungus, but in his scheme[22] for the treatment of plant diseases gives *Marasmius semistus* as the cause of the root-disease here.

The writer has pure cultures of at least two different basidiomycetous fungi which have been isolated from diseased cane roots. These fungi have not fruited in culture as yet, and none of the small mushrooms from the base of the stools have been sent away for identification. They are undoubtedly species of Marasmius however.

In stools affected by root fungus the basal parts of the leaf sheaths are matted together by a dense white mycelial growth. The young roots are blackened and infected with fungus. The disease which is known as blight is quite distinct and different from the root-disease in many ways. The root-disease as a rule is never serious on plant canes; it is primarily a disease of ratoon crops, while the blight may be as severe on plant canes as on ratoons. The blight makes its appearance after the rainy season is well advanced, and when there is abundant moisture in the soil, while the effects of the root-disease are most noticeable in periods of drought or just after the rains have begun. The root-disease as far as the writer has observed rarely attacks a whole cane field equally, certain stools being much more badly affected than others, while the blight seems to spread evenly over the whole field. Finally if the root-disease is severe enough in a field to cause the leaves to wither, the mycelium of the fungus is very evident at the base of the stools as a dense mouldy growth cementing the leaf sheaths together and spreading in the soil in fine white thread-like strands: while in many of the badly blighted cane fields which the writer has visited, the root fungus has been found only in small quantities. These facts would seem to preclude the idea that the root-disease is in any way the cause of blight or even a predisposing factor. Moreover, fields of second and third ratoons, rich in root fungus, are frequently found which show no signs of blight. There is no question of doubt that the root-disease does cause a considerable amount of damage in cane fields, but the blight as it occurs in Trinidad must be regarded as a distinct disease.

The leaf-spot is another fungus disease quite common in cane fields, but it is easily distinguishable from blight, for as the name suggests, the leaves become distinctly spotted before they wither and dry up.

The only other fungus disease which might be confused with blight is the so-called red-rot. The general appearance of plants affected with this disease suggests blight but when the canes are split open there is generally a red discoloration in the basal tissues of the stem.

Although the blight may be complicated by the presence of some of these fungus diseases, yet the fact that it may be found in typical form apart from them, shows conclusively that it is a distinct disease. As the froghopper is always associated with blight, and its attack on the plant would give, from a physiological standpoint, the exact symptoms of blight, it seems reasonable to suppose that this insect is the cause.

The writer[25] in his annual report for 1909 and 1910 mentioned that a fungus had been found on dead froghoppers and that experiments would be made to see whether or not it could be used as a means of control. The remaining portion of this paper gives the history of this fungus, results which have been obtained from its use in the field, and the possibilities of its usefulness from a practical standpoint.

HISTORY OF THE FUNGUS IN TRINIDAD.

So far as the writer knows, Hart[6] in 1890 was the first to observe that the adult froghoppers in Trinidad cane fields were attacked at times by a fungus, which he considered one of their natural enemies. The next mention of this fungus was in 1906 by Urich[13] who stated that on Orange Grove Estate a large percentage of the insects was being killed by a fungus, and in this way the brunt of the attack of blight seemed to have been checked. Later in the same year Hart[14] again mentioned the fungus and stated that it undoubtedly hastened the disappearance of the froghoppers.

Two years later Collens[17] found that froghopper nymphs confined in a breeding chamber together with perfect insects covered with the fungus became infected and died before reaching maturity, and later became covered with spores.

The writer[26] found the fungus in abundance during the past two rainy seasons especially in the months of August and September and began cultivating it artificially early in 1910, and published a brief report a few months ago.

The fungus is well distributed over the Island and is always found in any cane piece in which froghoppers abound, at times two or three dead insects may be found on the same cane plant, or even on the same leaf. The adult insects killed by the fungus do not fall to the ground but are found attached to the basal portion of the upper leaves.

IDENTITY OF THE FUNGUS.

As the writer[26] has previously stated a great deal of confusion has existed here as to the identity of this fungus. Hart[14] and Collens[17] considered that it belonged to the Entomophthoraceæ, while the material sent to the United States Department of Agriculture was determined as *Oospora destructor* or *Penicillium anisopliæ*,[23] and that sent to Kew as *Septocylindrium suspectum*, a new species.[24]

A cursory examination of the fungus shows that it is neither an Entomophthora nor a Septocylindrium. Specimens and cultures were sent by the writer to Dr. Roland Thaxter of Harvard University who determined the fungus as *Metarrhizium anisopliæ* Sorokin. *Entomophtora anisopliæ* Metschnikoff, *Isaria destructor* Metschnikoff, *Oospora destructor* (Metschni.) Delacroix, and *Penicillium anisopliæ* (Metschni.) Vuillemin are all synonyms. The fungus is of wide distribution and attacks a variety of insects of different orders and in different stages of development. A number of papers dealing with the fungus have appeared from time to time since 1878 in the mycological journals of Russia and France.

Metschnikoff[1] was the first to discover this fungus on the larvæ of *Anisoplia austriaca* the cockchafer of wheat in Russia.

He gave it the name *Entomophthora anisopliæ* and called the disease which it produced *la muscardine verte*. In the same year Sorokin[2] studied the fungus and concluded that it was not an Entomophthora and gave it the new name of *Metarrhizium anisopliæ*. A little later Metschnikoff[3] again studied the fungus and concluded that it belonged to the genus Isaria and gave it still another name, *I. destructor*. The same fungus was found in France in 1893 on silk worms and specimens were examined by Delacroix[7] who concluded that it belonged to the genus Oospora and so called it *O. destructor*, *Penicillium anisopliæ*, still another name, was given to the fungus by Vuillemin.[11]

A variety of the fungus which attacks the larvæ of Agriotis has been described from the United States by Pettit.[8]

From the above brief history it will be seen that though the fungus has been known and studied for a long time its systematic position is quite uncertain, and will probably remain so until some other type of spore formation is found. For some time past the writer has been studying the fungus and growing it under varying conditions to see if a perfect form of spore production could not be obtained but so far these efforts have been in vain. It seems quite certain that the fungus is not an Oospora or a Penicillium, and probably not an Isaria, though in some culture media it takes on a more or less tree-like growth, characteristic of that genus. As it cannot be left in the genus Entomophthora, where it was first placed, perhaps it would be better to call it *Metarrhizium anisopliæ* (Mitschni.) Sorokin, and consider it the type of that genus, which was created especially for this fungus and its characteristics are not those of any other described genus.

CULTURES OF THE FUNGUS.

Soon after discovering the fungus in 1878 Metschnikoff made pure cultures on beer mash gelatine and since that time it has been grown by a number of mycologists on a great variety of culture media.

The writer has experienced no difficulty in getting pure cultures by the ordinary poured plate method using potato agar as a medium. The fungus has been grown on various media, such as sweet and white potato cylinders, rice, beans, potato agar, horse dung agar, etc. It grows well on all of these but makes the most luxurious growth on starchy substrata such as white potato cylinders and rice. When sown in potato agar the spores germinate in four to six hours, generally with one, but at times two, germ tubes near the ends. (Plate I, fig. 3; 7 and 8.) The hyphæ soon branch and become septate. Within a week spore formation begins and continues for a long time, the mycelium spreading over the surface of the media and at times growing up the sides of the tubes or flasks. The sporophores are grouped together forming short stalks and the spores are cut off from the ends of the hyphæ in long chains which adhere together in cylindrical, cube like, or at times slightly fan shaped, masses. (Plate I, fig. 3; I.) The individual sporophores are simple, branched slightly, or even in a verticillate fashion, at times, resembling those of Penicillium. (Plate I, fig. 3; 3, 4 and 5.)

The prismatic masses of spores adhering together in fascicles are often 2 or 3 mm. in length and are olive green in colour. The individual spores are cylindrical, rounded, at the ends and measure 6–9 x 2–3 mikrons. (Plate I, fig. 3; 6.) Spores are formed much more quickly in cultures which are kept in the light than in those kept in the dark. The mycelium at times assumes a yellowish colour especially on sweet potato cylinders.

On insects the fungus has much the same appearance as in cultures. It attacks not only the adults but the nymphs as well. Spores which fall in the spittle surrounding the latter germinate there and the hyphæ soon

penetrate the soft body. On the perfect insects the necessary moisture for spore germination is furnished by rain or dew. When once within the insect the mycelium grows very rapidly and fills up the whole body cavity, thus killing the host. As soon as the insect is dead the mycelium comes to the outside in small white tufts through the thin spaces between the body segments. (Plate I, figs. 1 and 2.) These mycelial masses soon become confluent, spore formation begins, and eventually the whole insect is covered with a green powder. The attacked insects do not fall to the ground, but as a rule are fastened to the basal parts of the cane leaves by the mycelium of the fungus. (Plate I, fig. 1.) This is undoubtedly of great advantage for the spread of the fungus as the spores can reach other insects by contact and by wind dispersal from such a vantage point much better than if the diseased insects fell to the ground, though Collens [17] has expressed the adverse view. It is characteristic of a number of entomogenous fungi to force their host just before death to a high position and attach them there so that a good situation for spore distribution is obtained.

THE USE OF THE FUNGUS AS A MEANS OF INSECT CONTROL.

In 1880 Metschnikoff [3] suggested the possibility of using the fungus as a means of combatting the cockchafer of wheat (*Anisoplia austriaco*). He obtained quantities of spores for inoculation purposes from the rich mycelium which developed when insects that had died from the green muscardine were buried in wet sand and kept there for a few weeks.

Another of the early attempts to use the fungus economically curiously enough was for the destruction of *Cleonus punctiventris*, a curculio which attacks sugar beets. In 1884 Krassilstschik [4] and [5] made trials with the fungus and stated that by spreading the spores on the ground over infested areas, within ten to twelve days he found from 50% to 80% of insects infected.

These early experiments, however, were not carried very far evidently on account of the difficulty of getting spores in sufficiently large quantities, but the question of the possibility of using the fungus has been discussed from time to time in recent years by a number of Russian scientists, among whom may be mentioned Vilbouchewitch, Lindeman and Kalitaeff, the last being a strong partisan in favour of the use of the fungus. As yet however sufficient trials have not been made.

During the past four months the writer has carried on a number of inoculation experiments with the fungus on both adult and nymph froghoppers. The spores for these inoculations were obtained from pure cultures made in tubes and flasks on sterilized potato or rice.

On August 4, 1910, fifty adult froghoppers were caught by hand and put into a cage about one foot high by one foot and a half square made of wire mosquito netting and placed over growing grass in a cane trace. Twenty cu. cm. of water was poured into a tube containing a fruiting culture of the fungus. By shaking the tube vigorously the spores were wetted and became suspended in the water. This liquid was then sprayed through the netting of the cage containing the froghoppers with a small hand atomizer. The cage was removed on August 9, five days after the inoculation was made. During this period the weather was very favourable for the growth of the fungus, as gentle rains fell every day. The results of the inoculation were even better than had been hoped for. Not a single live insect was found, and though the ants had carried off many of the dead ones, nineteen were found well covered with the fungus. There can be scarcely any doubt that practically all of the insects died as a result of the inoculation rather than from a natural infection, for at this time it was

difficult to find diseased insects in the field in which the experimental froghoppers were caught. Again the cage was placed over the same patch of grass and new froghoppers introduced from time to time, but no more spores were applied.

Many became infected, but owing to the fact that the ants carried them away as soon as dead, it was impossible to get any accurate record of percentage of deaths due to the fungus. At about the same time a large number of young nymphs surrounded by spittle were collected from cane roots and placed in moist chambers containing sections of cane which had been rooted in moist saw dust. After a few hours, when the nymphs had established themselves on the cane roots, spores of the fungus were blown from a pure culture into the moist chambers which were kept in a dark place. Forty-eight hours after inoculation it could be seen that the fungus was taking effect, for some of the nymphs were no longer involved in spittle and could scarcely crawl about. By the sixth day 90 per cent. of the nymphs were dead and the fungus was beginning to fruit on those which had died first. From one hundred inoculated nymphs only three adult insects were obtained and one of these died soon after emerging, while from nymphs which were not inoculated but kept in dark moist chambers with cane roots, 90 per cent. perfect insects were bred out. Similar experiments have been repeated a number of times. That the disease is very infectious is again shown by the fact that healthy froghoppers soon become diseased if they are collected in boxes in which diseased insects have been previously gathered. Mr. Urich has found it necessary at times to sterilize all his froghopper collecting boxes, in order to bring in healthy insects for breeding purposes. The fungus attacks not only the cane froghopper, but other species of Tomaspis as well.

The only experiment in which the fungus has been used in the open field was briefly reported in a previous paper.[26] About two ounces of flour was poured into each of six flasks containing one month old cultures of the fungus. The flasks were then shaken so that the spores became thoroughly mixed with the flour. This mixture of flour and spores from the six flasks was dusted over one hundred cane plants in a field where froghoppers were abundant.

Despite the fact that immediately after the spores were scattered there was a very heavy downpour of rain which must have washed many of them away, the effect of the inoculation could be seen after a week's time. Although insects attacked by the fungus were found on the surrounding canes fully 50 per cent. more dead ones were found in the inoculated area. These experiments leave no doubt that the fungus is capable of killing larger numbers of froghoppers.

The problem yet to be solved is whether or not the fungus can be used on a larger scale under ordinary estate conditions.

CULTIVATION OF THE FUNGUS IN LARGE QUANTITIES.

In order to get spores in sufficiently larger quantities for practical field inoculation some methods other than those in everyday laboratory practice must be used for growing the fungus. The writer has designed what may be called a culture cabinet in which the fungus has been grown in quantity with almost no impurities. This cabinet may be considered as the unit and an indefinite number may be arranged in series. The cabinet is nothing more or less than a cupboard 6 feet high, 2 feet deep and 3 feet wide, the top, bottom, two sides and the back made of galvanized iron and the joints soldered. The front is a tight fitting door with two glass panes for the admission of light. Eleven galvanized iron shelves are arranged horizontally inside the cabinet at intervals of 6 inches and supported by brackets soldered to the side walls. Sets of two holes each,

about half an inch in diameter, are punched through the back of the cabinet midway between the top and the first shelf and each succeeding pair of shelves. These holes are plugged with cotton. The medium used for growing the fungus is boiled rice. The rice should be thoroughly washed and then put into boiling water and cooked for not more than ten minutes. It must not be pasty. This cooking sterilizes the rice and can be done in a large open pan or kettle. As soon as cooked, the rice should be dipped from the water with a perforated ladle or strainer and quickly spread in a thin even layer on all the shelves and bottom of the cabinet. The door is then closed. The heat from the rice in a way sterilizes the whole cabinet. After about two hours, or when the rice has cooled down enough, the inoculation may be made. Spores from one or two pure tube cultures are mixed with an ounce of flour, which has been sterilized in a dry oven, and placed in a clean insect gun or bellows such as is used for blowing pyrethrum powder into cracks and crevices. The cotton plugs are removed from the holes in the back of the cabinet, the end of the bellows tube inserted and the mixture of spores and flour blown into the cabinet through each hole in turn. The cotton plugs are then replaced. The spores germinate quickly in the rice and being present in such large quantities thousands of colonies start all over the surface. Within a few days the whole medium is covered with a dense mycelium. Spore formation soon begins and at the end of three or four weeks the maximum number of spores have been produced. A few colonies of Sterigmatocystis or of Aspergillus may come up here and there on the shelves but they do no particular harm and cannot gain a foothold, on account of the predominance of Metarrhizium.

Perhaps the best method of collecting the ripe spores has not yet been obtained. However they can be gathered fairly well by brushing them off or by the use of a vacuum cleaner or ordinary suction pump. Another method is to remove the shelves from the cabinet when the fungus is well fruited, let the medium dry and then shake the spores off through a fine sieve.

DIFFERENT WAYS OF USING THE SPORES.

There are a number of different ways in which it is possible to use the spores in the field. The only method which has been tried thus far is the dusting of the spores over the cane tops. This dusting could be easily done over large areas with a dusting machine such as is used for distributing various insecticides and fungicides in dry form. A machine of this kind would blow forth a cloud of spores which would be carried over the fields by the wind and many would gradually settle down into the cane leaf axils, a favourite hiding place of the froghoppers, and thus be in a position to infect the insects. Then too as the eggs are laid in the leaves the young nymphs as they hatch and crawl down the stem to the ground might also become infected.

Another method by which a green muscardine epidemic might be brought about is by catching the insects at night with lights, as many as 5,000 have been caught with a single lantern in a night, inoculating them and setting them free in the morning. A large percentage of these insects would contract the disease and die within a few days. The fungus would begin to fruit on the dead bodies and the spores in turn would serve as a source of infection to others, for as previously stated the insects usually die attached to the basal parts of the leaves, the favourite hiding place for the insects in the day time. If a systematic campaign of this kind were started just after crop time on an estate there is no doubt on the writer's mind but that the froghoppers could be kept under control.

The most essential point in favour of the use of the fungus being successful is the fact that the froghoppers are more active during the rainy season, the time most favourable for the growth of fungus.

Fig. 1. Froghoppers killed by inoculation.

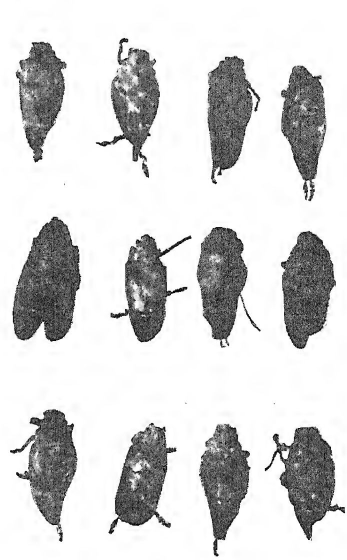

Fig. 2. Froghoppers killed by inoculation.

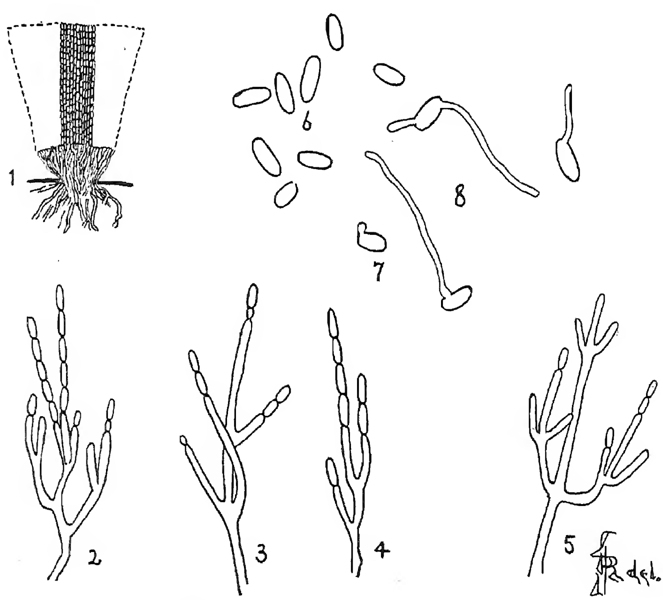

Fig. 3. Microscopic characters of the froghopper fungus.

DESCRIPTION OF PLATE I.

Figures 1 and 2.—Froghoppers which have died as a result of inoculation. In Figure 1 four froghoppers are shown attached to the cane leaves, the lower three are well covered with a powdery mass of green spores, in the upper one the white mycelium is just beginning to grow out through the thin places in the body wall of the insect. These dead insects were collected from the plants which had been dusted with spores. Figure 3.—Microscopic characters of the froghopper fungus. 1.—The mycelium growing out between the segments of a froghopper and bearing a block of spores. 2, 3, 4 and 5.—Different types of sporophores. 6.—Spores. 7.—Spore just beginning to germinate, six hours in potato agar. 8.—germinating spores after ten hours.

Figs. 1 and 2 magnified twice. Fig. 3; 1 x 125 : 2. 3, 4 and 5 x 400 : 6, 7 and 8 x 725.

Bibliography.*

1. 1879.—Metschnikoff, E. Zeitschrift der Kaiserlichen Landwirth Gesellschaft für Neurussland, Odessa, pp. 21-50, with plate.
2. 1879.—Sorokin, N. Zeitschrift der Kaiserlichen Landwirth Gesellschaft für Neurussland, Odessa, p. 268.
3. 1886.—Metschnikoff, E. Für Lehre über Insectenkrankheiten. Zoologischer Anzeiger, 3 : 41–47. Abstract by C V. Riley in American Entomologist 3 : 103. 1880.
4. 1886.—Krassilstchik, J. De insectorum morbis qui fungis parasiticis efficiuntur. Memoires dé la Société des Naturalistes de la Nouvellerussie. Odessa. Vol. XI. fas 1, pp. 75-172. Reviewed by A. Giard in Bulletin scientifique de France et de Belgique. Vol. 2. Series 3. 1889.
5. 1888.—Krassilstchik, J. La production artificelle des parasites vegetaux pour la destruction des insectes nuisables. Revue generale d'agriculture et de viticulture meridionales. June 5.
6. 1890.—Hart, J. H. Report on sugar cane blight. Agricultural Record of Trinidad. 2 : 127. Reprinted in Bulletin of Miscellaneous Information, Botanical Department, Trinidad. 7 : 153. October, 1906.
7. 1893.—Delacroix, G. *Oospora destructor*, champignon produisant sur les insectes la muscardine verte. Bulletin de la Société mycologique de France. 9 : 260–268. Pl. XIV., Fig. 11.
8. 1895.—Pettit, R. H. Entomogenous Fungi. Bulletin 97, Cornell University Experiment Station p. 356. Plate V.
9. 1895.—Wakker, J. H. Ein Zuckerrohrkrankheit verursacht durch *Marasmius sacchari*, n. sp. Centralblatt für Bakteriologie und Parasitenkunde. Ab. II. 2 : 45–56.
10. 1903.—Howard, A. On some diseases of the sugar cane in the West Indies. Annals of Botany, 17 ; 373–411. pl. XVII.
11. 1904.—Vuillemin, P. Les Isaria du genre Penicillium. Bulletin de la Société mycologique de France. 20 : 214–221. XI., Figs 1–8.
12. 1905.—Lewton-Brain, L. Preliminary notes on root disease of sugar cane in Hawaii. Hawaiian Sugar Planters' Station, Division of Pathology and Physiology, Bulletin 2, p. 39, Fig. 12.
13. 1906.—Urich, F. W. Froghoppers The Mirror, Port-of-Spain, Trinidad, September 19.
14. 1906.—Hart, J. H. Cane diseases. Bulletin Miscellaneous Information. Botanical Department, Trinidad. 7 : 153.
15. 1907.—Barrett, O. W. Blight in sugar cane. Proceedings of the Agricultural Society of Trinidad and Tobago 7 : 251, 252.
16. 1908.—Fulton, H. R. The root disease of sugar cane. Louisiana Agricultural Experiment Station, Bulletin 100, pp. 21. 8 figures.
17. 1908.—Collens, A. E. Sugar cane blight and the froghopper. Proceedings of the Agricultural Society of Trinidad and Tobago. 8 : 152.

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18. 1909.—Cobb, N. A. Fungus maladies of the sugar cane. Hawaiian Sugar Planters' Station. Division of Pathology and Physiology, Bulletin 6, p. 30, Plate I and 17 figures.

19. 1909.—Stockdale, F. A. Root disease of sugar cane. West Indian Bulletin, 9 103-116.

20. 1909.—Carmody, P. To the members of the cane blight committee. Proceedings of the Agricultural Society of Trinidad and Tobago 9 : 107.

21. 1909.—Collens, A. E. Result of inspection of cane blight disease at Brechin Castle Estate. Proceedings of the Agricultural Society of Trinidad and Tobago. 9 : 121-124.

2. 1909.—Collens, A. E. Plant diseases. Bulletin of Agricultural Information, Department of Agriculture, Trinidad. 8 : 39.

23 1909.—Bulletin Agricultural Information. Trinidad, 8 : 45.

24. 1910.—Bulletin Miscellaneous Information, Royal Gardens, Kew. No. 1 p. 4.

25. 1910.—Rorer, J. B. Annual report of Mycologist, Board of Agriculture, Trinidad.

26. 1910.—Rorer, J. B. The froghopper fungus. Report to the Board of Agriculture, Trinidad. Issued September 25.

(AGRICULTURAL SOCIETY PAPER NO. 448).

Identification of the Sugar Cane Froghopper.

BY F. W. URICH, Entomologist, Board of Agriculture.

THERE has always been some doubt as to the identity of the Sugar Cane Froghopper. In his article in the Agricultural Record, Vol. II, 1890, p. 126, Mr. J. H. Hart, F.L.S., mentions that Mr. R. McLachlan, F.R.S., decided that this insect belonged to the family *Cercopidæ*, but it could not yet be ascertained that the particular species was known or described. Subsequently the insect was referred to by Hart, Collens and Barrett as *Tomaspis postica*, Walker. Mr. Heidemann of the United States Department of Agriculture, to whom I referred a series of sugar cane froghoppers, determined them as two species, viz : *Tomaspis postica*, Walk, and *Tomaspis postica* var. Walk. Professor E. D. Ball, an authority on Cercopidæ, was good enough to offer me his help in connection with the identification of these insects and after examining a long series from Trinidad determined the sugar cane froghopper as *Tomaspis varia* Fabr. In his letter the Professor mentions that the true *T. postica* was taken on sugar cane in Mexico, but that this species is quite different to our sugar cane froghopper. The following is a list of the froghoppers recorded from Trinidad—fully illustrated descriptions will be published later.

(1.)—TOMASPIS VARIA, Fabr.—(Sugar Cane Froghopper).

Tomaspis varia, Fabr.—Mant. Ins. II., p. 274, 1787.
Ent. System IV, p. 51, 1794.
Syst. Rhyn p. 94, 1803.
Stal. Hemip. Fabr., p. 13, 1869.

Distribution: Trinidad—(*Crew, Hart, Collens* and *Urich.*) Tobago—(*Guppy*). Food plants. Grasses of several species and sugar cane. Adults are sometimes observed feeding on palms.

In colour the adults vary a great deal regardless of sexes. In some individuals yellow predominates, giving the insects quite a light appearance and in others the yellow markings dwindle away to a few spots, leaving the dark-brown colour almost predominant—Length 7-9 mm. This Froghopper

is very common in Trinidad, being found on sugar as well as cacao estates all over the Island.

(2.)—TOMASPIS RUBRA, Linn. var *sororia*, Germ.—(Christmas Bush Froghopper).

Distribution: Trinidad—(*Guppy*, *Caracciolo* and *Urich*). Demerara —(*Moore*). Food plant: *Eupatorium odoratum*, Christmas bush. Not found on grass up to now.

This is a handsome black and yellow species found commonly on cacao estates. Some individuals are black and orange—Length 10-11 mm.

(3.)—TOMASPIS PUBESCENS, Fabr.—(Black Froghopper).

Distribution: Trinidad—(*Guppy* and *Urich*). Demerara—(*Moore*) Food plants. Several species of grass growing in damp situations.

This species is quite dark with a golden pubescence and on the whole an uncommon insect in Trinidad, occurring in numbers occasionally in certain localities.—Length 7–9 mm. It is generally found in company with the preceding species on cacao estates. Mr. Moore says that it is one of the commonest and most abundant froghoppers in Demerara, being found from the very sea coast to the far interior.

(4.)—TOMASPIS sp. near *tristis*. Fabr.—(Spotted Froghopper.)

Distribution: Trinidad—(*Guppy*.)

This is the largest species of froghopper recorded from Trinidad up to now. Length 12–13 mm. It was found by Mr. Guppy at Chatham and is a handsome, large species, dark brown with orange spots running across the wings in two irregular bands. The immature stages are not known.

The Palm Weevil as Sugar Cane Pest.

By LEWIS H. GOUGH, Ph. D.

DURING a visit to San Fernando and the Usine *Ste. Madeleine* on November 1st, 1910, I was shown a field of cane plants at *Union Hall* Estate which was suffering from an attack by beetle-grubs. The damage done was considerable, quite 25 per cent. of the plants having been killed, and many more injured or checked in their growth, some of which however subsequently recovered. On examination the injured plants were found to be more or less hollowed out or tunnelled through by legless beetle grubs. In every case the tunnels were recognisable as minute perforations about $\frac{1}{25}$ of an inch in diameter at $\frac{1}{2}$ to one inch from the upper, exposed, cut surface of the cane-plant; as the surface itself was rough and weathered, the actual point of entry was not evident. The burrows were found to descend almost vertically into the body of the cane, widening considerably after the course of a couple of inches; when passing the "eye," the tunnel almost invariably turned towards it, and in passing quite close to the base of the shoot usually killed the young plant. Then the tunnel turned back into the body of the cane and assumed its largest dimensions in the internode behind the bud. The basal portion of the cane was often completely hollowed out, although the field had only been planted five weeks before examination. The grubs were not however all in the same stage of development, showing that the plants had been attacked on several successive occasions. I also found the same beetle larva in some ratoon canes in a field close by.

From the appearance of the grubs I inferred them to belong to the PALM WEEVIL, *Rhynchophorus palmarum* L. and to be what is locally known as "Grugru Worms." As method of control I recommended

coating the exposed cut surface of the plants with tar or some similar substance to prevent the weevils from laying their eggs in the soft tissues of the cane, or else planting the canes in such a manner that no portion of the plant is exposed.

Grugru Worms are one of the oldest known parasites of the Sugar Cane, and have been repeatedly observed in various other parts of the West Indies besides Trinidad. They were first recorded as Sugar Cane pests in 1828 by the Rev. Lansdown Guilding. In 1847 they were observed by Sir Robert Schomburgh at Barbados, attacking recently planted cane-plants. In 1880 Miss Ormerod received specimens from Sugar Cane grown in British Guiana. In Trinidad it has been observed more than once as an enemy of cane cultivations. In 1900 Mr. Hart recorded a case in a cane in the Experimental Station, St. Clair, discovered by Mr. Collens. Since then it has been reported on by Mr. Urich in his annual report for the year ending 1910 and in his monthly reports to the Board of Agriculture. It does not seem to have been reobserved in Barbados during recent years, as no record of it can be found in the *West Indian Bulletin*, nor is it mentioned in that journal in any of the lists of enemies of the Sugar Cane.

THE EGGS.

The eggs are elongate, with rounded ends, usually somewhat curved, white or cream-coloured objects; they measure $\frac{1}{36}$ of an inch in diameter by about $\frac{1}{10}$ of an inch long. A small mass of dark tissues, derived from the mother-beetle adheres to one end of the egg, and forms a plug to the hole in which the egg is laid.

When cane-plants are chosen by the Weevil to deposit her eggs in, the beetle first bores a hole into the parenchymatous tissues of the cane with her ovipositor and lays an egg at the bottom of the hole. The beetle does not seem to be able to bore through the rind, but always attacks from the exposed, cut surface. When ratoons or older canes are attacked the eggs are probably deposited into the softer tissues at a spot where the cane has been broken or cracked. In the same way, when depositing eggs in a palm-tree, wounds probably form the port of entry for the eggs. In the cane, the eggs are laid at a depth of about $\frac{1}{4}$ of an inch. They are deposited singly, in a vertical or slightly diagonal position, each one in a separate hole, but more than one egg is frequently deposited in the same cane-plant.

I have observed eggs to hatch in less than 48 hours.

Mr. Urich in his report to the Board of Agriculture of Trinidad has asserted that the beetles only attack fermenting canes: this does not agree with results obtained experimentally; the beetles have laid their eggs in my breeding-cages quite freely in recently cut pieces of cane, where there was no sourness and no fermentation was taking place.

From information received, the softer kinds of cane appear to be most frequently attacked. Mr. Robertson of *Union Hall* Estate reports to me that damage was done in 1909 chiefly to cane D 625, and in 1910 to B 147 and B 347.

THE LARVA.

The Larvæ are milky white or cream-coloured legless grubs with mahogany brown heads and horny yellow anal plates. They grow to about $2\frac{1}{2}$ or 3 inches in length.

They pass through at least seven stages before pupating, the stages being fairly readily identified by the measurement of the greatest width of the head. 27 specimens were measured, and fell readily into seven groups. The measurements are given in millimeters on Table I.

TABLE I.

Diameter of Head of 27 Larvæ of the Palm Weevil.

Stage I (just hatched).	Stage II ?	Stage III ?	Stage IV ? (fourth from last stage.	Stage V ? antipenultimate stage.	Stage VI ? (penultimate).	Stage VII ? (last stage.
0·7 mm.	2·5 mm.	3·2 mm.	5 2 mm.	6·5 mm.	7·8 mm.	9·2 mm.
0·7 ,,	...	3·2 ,,	5·2 ,,	6·5 ,,	7·6 ,,	9·2 ,,
		3·2 ,,	...	6·5 ,,	7·4 ,,	9·0 ,,
		3·0 ,,	...	6·4 ,,	7·3 ,,	9·0 ,,
		3·0 ,,	...	...	7·3 ,,	
		3·0 ,,	...	...	7·2 ,,	
		3·0 ,,	...	...	7·2 ,,	

There seems to be a hiatus between Stages I and II, and one between Stages III and IV which may perhaps be bridged by further stages, in which case there would be nine stages instead of seven.

Owing to the burrowing habits of the grubs it was impossible to obtain data to show the exact length of each stage, the total period however appears to be about three months, but probably varies according to temperature and food supply.

The last stage has been very minutely described by W. F. H. Blandford (The Palm-Weevil in British Honduras, *Kew Bulletin*, 1893).

The grubs live singly in their tunnels, should two tunnels meet, one of the larvæ is invariably killed and eaten by the other. Consequently one more frequently finds several specimens of the younger stages in a cane plant, than more than a single one of the elder stages. They can tunnel very rapidly, a specimen two days old had penetrated two inches. A grub of the last stage can completely hollow out a piece of cane a foot and a half long in a week. In my breeding cage, the older larvæ would leave the piece of cane they were feeding on, when they had finished all that was in it and enter another piece. The youngest grubs apparently bore downwards, the tunnel however turns upwards again as soon as the entire length of the plant has been bored.

When they have reached their full growth they leave the cane-plant and build a cocoon of fibres in the ground. The long axis of the cocoon (and of the pupa) is directed in most cases vertically.

The Pupa.

The pupa is clay-coloured, with darker brown colour on head and antennæ, the tips of the rostrum, the margins of the thorax, tips of the legs and on the margins of the elytræ or wing sheaths. It measures about $1\frac{1}{2}$ inches long. The pupal stage in my experience does not last long, about 2 to 4 weeks, though it may perhaps be gone through in less time or last longer according to circumstances.

The Adults.

The adults vary considerably in size, from about $1\frac{1}{4}$ inches to $1\frac{3}{4}$ inches being the usual limits. They are velvety black coloured beetles, with a

long rostrum. The males can be readily distinguished by having a dense pubescence on the upper surface of the rostrum, which is absent in the female.

The legs are very strong, and possess a strong curved spine on the tibia. When burrowing into a cane, or other vegetable matter (decaying palm-trees, or banana stumps) in search of food, these spines are used to dig with, the slender tarsus being folded back over the tibia and kept out of the way.

Some Palm-weevils I kept in captivity entirely hollowed out pieces of cane $1\frac{1}{2}$ feet long in search of food. I have been able to keep them alive for two months.

Copulation takes place frequently, and during the day. The beetles fly chiefly in the early morning and in the later part of the afternoon. The females continue laying for a long period, the average output of eggs being about five a day.

It is a well known thing that the easiest way to obtain the beetles is by felling a palm-tree; the beetles are attracted by the fermenting juices and may be found in numbers on the next few days on the cut down trunk and also to a less extent on the stump, eggs are then laid in the palm-trunk. There are however frequent observations to show, that palms are sometimes attacked when quite healthy. A case of this nature was recently brought to my notice by Mr. Thornton of Tobago. He reports that he observed a hole in a five year old, perfectly healthy palm-tree. Examination revealed the presence of a grugru-worm. The tree was then cut down and split lengthwise, and was seen to be free from any disease, other than that caused by the burrowings of the beetle-grubs. Adults can also be collected on the stumps of bananas that have been cut down. I obtained all my experimental material by searching the places where cane-plants were being cut; by raking up the short lengths of cane which form the refuse of cutting plants, one is almost always rewarded by finding beetles. Eggs can frequently be found in the short lengths of cane forming the litter of the cane-plant chopping places.

Up to the present the Palm weevil does not seem to have done much damage to cane cultivations in Trinidad except on *Union Hall* estate, the beetles are however frequent on all estates, and the damage done by them may perhaps have been only on a very small scale, or not been noticed. I am informed that they can be caught in large numbers around the mills and the unloaders during crop-time.

Remedies.

The prevention of the attack of the Palm weevil on cane-plants is quite simple, if the remedy used is a suitable one, and its object is understood.

In the first place it must be borne in mind, that Bordeaux mixture is of no use whatever against the palm-weevil. Bordeaux mixture is not an insecticide, and the amount of it that gets deposited on the ends of the cane plant is so small as to be practically harmless to animal organisms. Beetles in my cages, laid eggs in and fed on canes dipped in Bordeaux mixture quite impartially, not dipped canes being also available. The mixture had naturally no effect whatever on the insects. As the eggs are laid after the plants have been placed in the ground there is no reason to hope that they should be drowned and killed by the immersion in the liquid before planting.

Should we substitute some more powerful poison or insecticide for the Bordeaux mixture, and immerse the plants in it, for instance in an arsenical solution or mixture, the result would be equally negative. As I have

already stated, the eggs are laid deep into the softer tissues of the cane; a poisonous coating on the cut surface of the plant would not be able to injure the egg, nor to poison the young recently hatched grub, as that individual would never come in contact with the poison.

As it is hopeless to expect to control the Palm weevil by poisoning its eggs or newly hatched grubs, the only method remaining is to prevent eggs being laid in the cane-plants, and various methods to effect this suggest themselves: for instance extirmination of the adults, coating the cut surface of the cane with a substance repellant to the beetle, or with a substance which would prevent the insertion of the eggs, and finally planting in such a manner that the beetle cannot find the cut surface of the plant.

The chances of success if an attempt is made to extirminate the adult beetle are not good, as it would be both too expensive and too uncertain. Various measures to bring about the extermination of adult beetles have however been suggested, and tried on coconut estates, where this method is the only one practicable. Felling palm-trees to attract adult beetles which are then captured and destroyed, and the destruction of the log later on when the larvæ have not yet reached maturity has been recommended (*see* Hart *Bulletin Miscellaneous Information*, 1905 p. 159), and practised. In 1900, Hart recommended wounding Grugru trees to attract the beetles away from the sugar-canes. (*Bulletin Miscellaneous Information*, 1900, p. 289.)

Without the necessity of incurring the expense of felling palm trees which are not always handy, something can be done on Sugar Estates to reduce the numbers of the beetles. I have already referred to the attraction for the beetles of the places where cane-plants are being prepared. The usual practice is to leave the trimmings to rot on the spot. I should certainly like to suggest that a little more attention might be given to the trimmings. Under the present circumstances they serve as a breeding place for various insects and fungi, which are being taught to acquire a taste for sugar cane, and to adapt themselves to it. Numbers of the beetle and of its eggs could easily be destroyed at but little cost if the litter was properly disposed of. (Would not the trimmings if sent through the chop-chop machine be acceptable as food for stock ?)

Dipping the ends in a substance such as dilute Creosote, Lysol or Carbolic acid would keep the beetles away, by masking the sugary smell of the cane, for as long as the chemical used lasted, which would probably not be very long in wet weather. These chemicals would support the fungicidal action of the Bordeaux mixture, their action in the control of the Palm-weevil would not be that of an insecticide, but merely on account of their smell, which is more or less offensive to the beetle, or at any rate overpowers the attractions of the smell of the cane.

Treating the cut ends of the plants with a substance, which will prevent the insertion of the eggs and whose action is of unlimited duration is more advisable; such substances are tar, resin, asphalt, or compounds of one or other of them with grease, the addition of which should make the coating more elastic and more durable. The Board of Agriculture (England) in Leaflet No. 162 gives the receipt for a tree-wax which might be tried. It consists of equal parts of Burgundy pitch, kerosene wax and tallow. Barrett's compound is also worth trial, it costs $0.80 a gallon.

No mention can be made of the desirability of combining the use of Bordeaux mixture with the tarring of the ends of the plants without reference to a paper by Albert Howard in the *West Indian Bulletin*, Vol. III, 1902, pp. 73–85, which is well worth reading. In this paper a series of experiments is discussed, in which the germinating power of a large number of cuttings is compared, which had been subjected to various

treatments, or been left untreated. The experiments were undertaken with reference to the pine-apple disease (*Thielaviopsis ethaceticus*), and showed the great superiority in germinating powers of plants soaked in Bordeaux mixture, or such treated by having their ends tarred after being soaked in Bordeaux mixture, over untreated plants, and plants treated with various other solutions. On Table VII, p. 80, loc. cit., one finds that of 100 plants treated with Bordeaux mixture and tar 96 per cent. germinated, whilst only 44 per cent. of the 100 treated with Bordeaux mixture alone survived: this experiment was undertaken during dry weather, during wet weather the superiority of Bordeaux and tar over Bordeaux mixture alone was not so remarkable.

Howard gives as estimate as to the quantity of tar required to coat the ends of 6,000 cuttings one gallon, the price in Barbados 10 cents, here coal tar would be 36 cents. From his calculations it would appear that the labour required for tarring is double that necessary for treating with Bordeaux mixture alone, and that 3 boys ($2\frac{1}{2}$ by calculation) would be able to tar 6,000 cuttings a day. The work could not be done as cheaply in Trinidad as was then possible in Barbados. Howard reckoned 8 cents a day for each boy, here it would be nearer 25 cents, making $0.75 for labour + $0.36 for tar together $1.11 for five acres or $0.22 for one acre.

Finally, it would be possible to protect the plants from the attack of the Palm-weevil by planting flat with both ends covered by the soil, the method having the additional advantage of not costing anything beyond the mere price of planting. Some plants were planted at *Brechin Castle* in this manner and gave satisfactory results. Planters here fear that the young plants would not be able to push their way through the heavy soil; where the beetle does damage planting flat should at least be given a trial. The other objection to planting flat is, that supervision is not quite so easy as planting slanting.

Explanation of Plate.

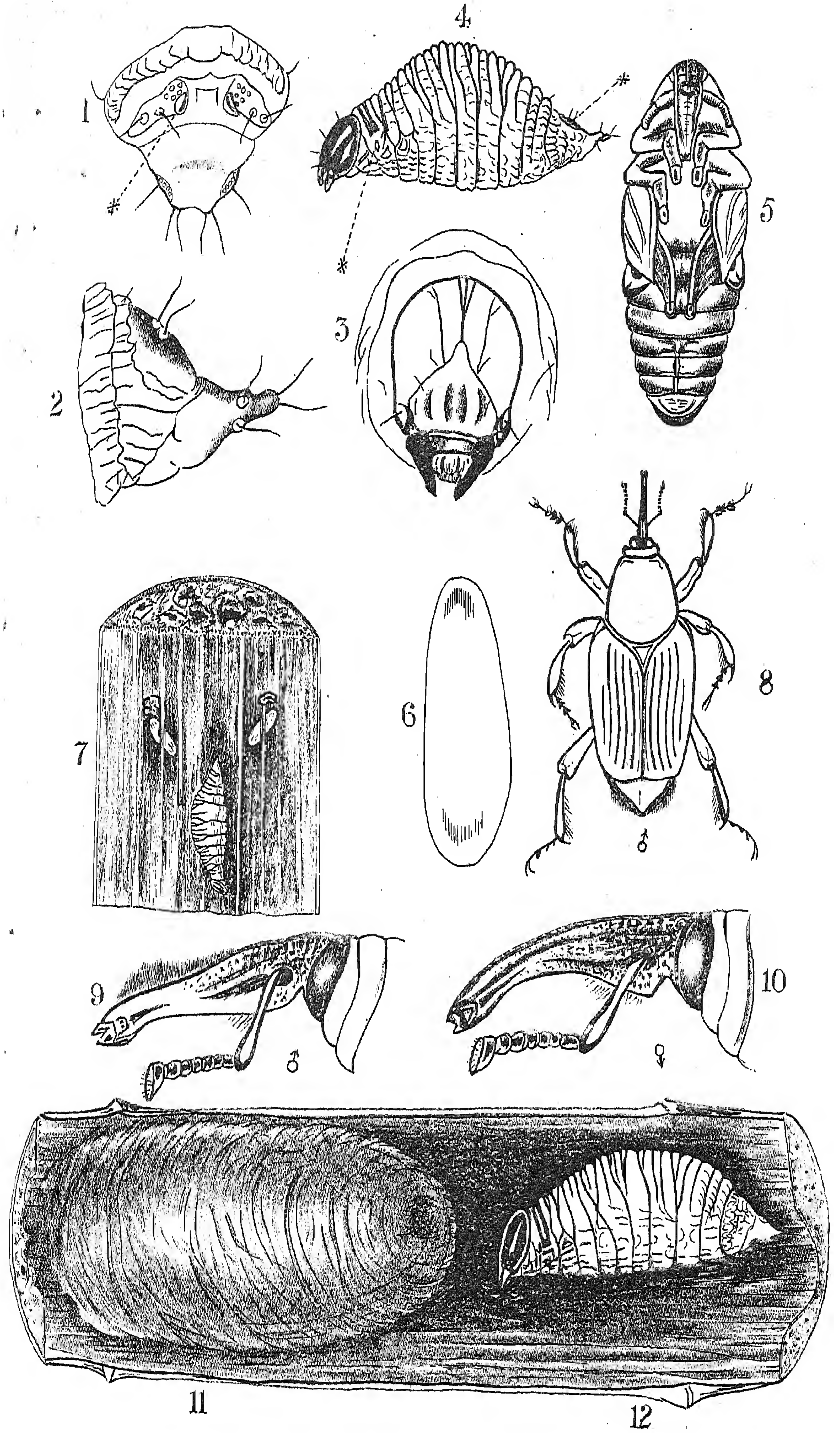
Rhynchophorus palmarum L.

1, 2. Last segments of an old larva, from above and from the side.
3. Head of larva.
4. Larva of last stage.
5. Pupa.
6. Egg, much magnified.
7. Section of cane plant, showing position of the eggs, and a young larva.
8. Adult male.
9. Rostrum of male.
10. Rostrum of female
11. Cocoon.
12. Larva of last stage.

The plate has been drawn by Mr. P. L. Guppy.

LEWIS H. GOUGH.

February 14th, 1911.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Sugar Cane Wax.

We are indebted to Professor G. Barger, Professor of Chemistry at the East London College, for the following review of Mr. A. Wijnberg's recent book in Dutch on "The Wax of the Sugar-cane, and the Possibility of its Technical Production,"* which has been presented to Kew by Professor G. van Iterson, of Delft.

The book under review is a dissertation from the newly founded botanical laboratory (Prof. G. van Iterson) of the Technical High School at Delft, and deals in an exhaustive manner with the possibility of commercially utilizing the wax-coating of the sugar cane. In addition there is an account of the chemistry and biological significance of vegetable waxes in general.

The botanical part of the investigation completely confirmed the results of De Bary's investigations; the origin and structure of the wax coating is illustrated by drawings of microscopical preparations.

Chemically the wax of the sugar-cane was examined as long ago as 1840 by Avequin (*Ann. Chim. Phys.*, [ii], vol. 75, p. 28), and an analysis of it was made by the celebrated chemist Dumas. The material for this examination was obtained by carefully scraping the outside of the cane, a process which is of course not applicable on a large scale. The author of the present treatise has therefore used another method, starting from the so-called "filter dirt," a waste product of the Java sugar industry. When the cane is crushed, and subsequently extracted with hot water, nearly all the epidermal wax passes into the crude juice, where it remains suspended, until the juice is purified by the addition of lime and subsequent boiling, when the wax is carried down in the precipitate formed. Thus on filtration the wax is found in the so-called "filter dirt" which remains in the filter press, and which may contain 10 per cent. or more of wax.

By extracting fresh filter dirt with ligroine (light petroleum) a complicated mixture is obtained, consisting mostly of fats (glycerides of oleic and linolic acids), and about 30 per cent. of wax. If the filter dirt has fermented for some time, the fats have disappeared and the ligroine extract consists mostly of the wax, which is more resistant to bacterial action. The wax may be separated from fats by crystallisation from ligroine, in which it is less soluble; it then consists chiefly of myricyl alcohol and a substance of the formula, $C_{33}H_{68}O$.

The crude cane wax, thus obtained, melts above 80° and is still dark coloured. It may be bleached by means of chlorine, when it is, however, attacked to some extent. The colouring matter may also be removed by adding fuller's earth or a similar substance to the melted or dissolved wax, and allowing to settle. The product, refined by this mechanical process, closely resembles the valuable Carnauba wax, obtained from the Brazilian Palm *Copernicia cerifera*. It would appear that the latter wax can be replaced in most cases by cane wax, so that there ought to be a market for the latter article. The author advises sugar works to keep their filter dirt and let it ferment, with a view to ultimate extraction. The extraction of the crude material is being started in Java, where, it is calculated, more

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* "The Wax of the Sugar-cane, and the Possibility of its Technical Production." By A. Wijnberg, Amsterdam, 1909, pp. 198, with 2 figures and five plates.

than 4,000 tons of wax should annually be obtainable. At present, it is impossible to estimate the commercial value of cane wax with any degree of accuracy. Since it is much harder than beeswax, and closely resembles Carnauba wax, it is thought that it might be almost as valuable as the latter article, which is worth at least 11*d.* per lb. The author estimates the cost of producing refined cane wax on the large scale at 2*d.*–3*d.* per lb.

In the development of a chemical industry the utilisation of waste products is often of great importance; whether the wax of the sugar cane can be utilised technically remains to be seen, but in any case Mr. Wijnberg's book is a most important contribution towards the solution of the problem.—*Kew Bulletin*, No. 9, 1910.

Section II.—CACAO.

The Cacao Thrips (*Heliothrips rubrocinctus*, Giard)

BY

F. W. URICH.

WITH THREE PLATES.*

Introduction.

THIS insect has always been present on Cacao estates in the West Indies, but it was not until 1898 that attention was called to the "blight" it was causing to Cacao pods in Grenada, by Mr. W. E. Broadway, Curator of the Botanic Gardens there. Specimens of the insects were forwarded to the British Museum, and Mr. Waterhouse determined them as a species of *Thrips*. From specimens sent to M. Giard at Paris from Guadeloupe this insect was named *Physopus rubrocincta*. In 1908 Mr. H. J. Franklin changed the generic name to *Heliothrips* and gave descriptions of the male, female and larval stages. With regard to the economic status of *Thrips*, Mr. Broadway mentions in 1898 that Thrips caused Cacao pods to become thoroughly discoloured as they approached maturity, the pods also developed an unnatural hardness, although no change in the interior was noticed. In his annual report of 1900, Mr. Broadway again mentions *Thrips* and says :—"The Cacao *Thrips* first brought to notice by this station, in the year 1898 spread to many estates throughout the year. Their attacking young and old leaves of the cacao tree was a new and more serious feature. Hitherto *Thrips* had only been noticed on pods."

In 1900 Mr. Maxwell Lefroy investigated the so-called Thrip disease in Grenada, and issued a report on the control of this insect. The summary of this report reads as follows :—"It may be of use to shortly sum up the present position of *Thrips* in Grenada. *Thrips* may be regarded as a possible enemy to Cacao rather than an actual pest. There does not appear to be any serious cause for alarm at the

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* For plates *See Bulletin* of the Board of Agriculture dated 24th February, 1911.

present time, and the chance of the Cacao suffering materially from the attack of this insect is, in my opinion, remote."

In 1903 in the *Agricultural News*, Vol. II, p. 66, *Thrips* is considered not a very serious pest, except in certain districts in Grenada. In 1904, Mr. Ballou says in connection with *Thrips*:—"I visited *Hope* Estate, Grenada, where the Cacao was reported to be badly attacked by *Thrips*. I found that the latest serious attack occurred in November and December, 1903. In one field of about 2 acres the trees were entirely dead, and I was informed that this was due to the attack of *Thrips*." Quite recently in the *West Indian Bulletin*, Vol. XI, No. 2, Mr. Ballou refers to *Thrips* as follows:—"*St. Vincent.*—These are reported as having been responsible for a considerable amount of damage on several estates, especially when the conditions of growth are unfavourable; the soil being poor, or the shade insufficient. *Grenada.*—There have been slight outbreaks of these insects on Cacao leaves and pods, but no treatment has been given. The dampness of the year may have kept them in check. *St. Lucia.*—They were of general prevalence, but were most frequently observed in t' e Spring months, and again in August and September. They are apparently of more importance on Cacao growing in bottom lands. *Virgin Islands.*—Some of these insects occurred on Cacao growing at the Botanic Station."

In 1909 Mr. Broadway reported the occurrence of *Thrips* on Cacao pods in Scarborough (Tobago). Mr. P. L. Guppy found them later on Cashew near Roxborough (Tobago).

Records of Thrips in Trinidad.

Mr. J. H. Hart writes with reference to *Thrips* in this island:—"*Thrips* or Thrip is common in Grenada and other Islands, but is little seen in Trinidad except in dry exposed situations. Our observations tend to show that it occurs more plentifully in unshaded plantations." As far as my experience goes I have always observed *Thrips* on Cashew and Cacao whether shaded or not. Until 1909 it did not strike me as being a particularly injurious insect in Trinidad. Mr. Broadway called my attention lately to the fact that *Thrips* also attacks mangoes very severely, especially in the dry season and when the trees are in poor health.

Food Plants and Distribution.

The Cashew tree seems to be one of the favourite food plants of Thrips, and I am inclined to think that it may be the original one. In some localities certain Cashew trees lose their leaves regularly through the attack of *Thrips*. I have also observed *Thrips* on Cacao, Guava, Roses, Almond (*Terminalia catappa*) and Mango.

The distribution seems to be a wide one also. It has been recorded from Grenada, St. Vincent, St. Lucia, Dominica, Guadeloupe, Virgin Islands, Tobago and Uganda; it is not at all unlikely that it was introduced into the latter place on Cacao pods from the West Indies. The insect recorded from Ceylon, does not appear to belong to the same species as the one under review.

Nature of Injury.

The feeding and ovipositing of *Thrips* cause injury to plants. Although small these insects cannot be disregarded as pests on Cacao estates, and they ought to be carefully watched and kept under control if they show the least tendency to increase in numbers. The most serious damage to the plant is done to the leaves; pods are also affected, but in a severe attack the leaves are so seriously injured that they drop off and a so-called "change of leaf" takes place. The results of a change of leaf as is well known in Trinidad causes all young pods to wither. Up to now severe attacks have not been frequent, but one occurred in 1909 in the Guaico District and indicates that *Thrips* is an insect not to be treated with contempt. Adults and larvæ obtain their food by puncturing the epidermis of the leaf, generally on the underside, draining the cells of the leaves of their contents; in a young cacao leaf the puncture is transparent, and as the leaf grows older this spot becomes dry and brown. Allowing for hundreds of insects feeding on each young leaf, it will be readily understood the drain of plant food which takes place and besides rendering the leaf partially useless for its functions, causes it to dry up and consequently drop prematurely. In a very severe outbreak both old and young leaves are attacked, the young leaves of the suckers looking as if scorched, and the old leaves turning brown. The leaf figured on Plate XX represents an old leaf pretty badly attacked. Leaves showing only one or two brown patches can always be seen on any Cacao estate and represent patches damaged by small colonies of *Thrips*. The darker spots are caused by the excrement of the insects which is deposited in a liquid state and dries up in the shape of minute flakes. Plate XIX represents a pod badly attacked and of the characteristic russet colour. The reddish spots are caused by excrement which dries up, as on the leaves, in the shape of thin flakes. Pods of such colour may still harbour all stages of the insects. I have never observed this species of *Heliothrips* on Cacao or any other flowers, and it is fortunate that this species of *Thrips* confines itself to the fruit and leaves of the Cacao, as bad as this may be at times. The *Thrips* supposed to fertilize the Cacao flower and also found in Immortelle flowers belongs to quite a different genus.

Description.

Heliothrips belongs to the order of insects called Thysanoptera, which comprises small insects varying in length from $\frac{1}{50}$ to $\frac{1}{3}$ of an inch. The genus Heliothrips is characterised by the body, especially the head and prothorax, being of a deeply reticulated structure. Head broader than long, with a very irregular and rough outline. Antennæ eight segmented. Legs unarmed. Wings, four in number, present. Mr. Dudley Moulton* thus describes the mouth parts:—"The mouth parts of *Thrips* project from the lower posterior side of the head and have the appearance of an inverted cone. The mouth opening is in the small distal end, and through it the stylets or piercing

* In "The Pear Thrips," Bull. 68, Part 1, Bur. Ent., U.S. Dept. Agr., pp. 2–3, 1907.

organs are projected when the insect is feeding. The rim at the tip is armed with several strong chitinous points, which figure prominently in tearing open the plant tissues. The insect first pierces the epidermis with the stylets, then removing the cone tip backward and forward, it enlarges the opening and lacerates the plant tissue by means of the barbed snout. It then pushes the tip of the mouth cone into the puncture thus made and sucks in the plant juices. Larvæ feed in a similar way, having similarly constructed mouth parts."

ADULT. (PLATE XVIII, FIG. 1).—The figure represents an enlarged painting of a female with her forewings closed over her abdomen, a position in which she would generally be seen on a Cacao leaf in the field when undisturbed. When recently hatched the adult has the forewings white, head and thorax light green almost white translucent, eyes dark red, abdomen dull reddish brown at tip with the red band of the pupa showing at the base. In a few hours the insect assumes its full colouration, and when magnified looks like Fig. 1. With the naked eye or with a low power field lens it appears black, the antennæ showing up black and white. The female is provided with an ovipositor by means of which she makes an incision in the leaf and pod tissues and pushes an egg into it.

The total length of the female is about 1·12 mm., and the greatest width of the thorax 0·30 mm. As a rule only females will be found, the males being rare and appearing only at certain seasons. The male has much the same appearance as the female, but can be distinguished at once by its smaller size and tapering and slender abdomen. Total length of male 1.08 mm.

THE EGG.—As dissected out of the female the egg is kidney shaped 0·225 mm. long and 0·105 mm. wide, with a very thin shell and quite transparent.

LARVA FIRST STAGE.—When recently hatched the larva is quite white and transparent, with claret coloured eyes, the head is almost square and the abdomen tapering, giving the insect a fusiform appearance, the antennæ and legs are long as compared with the size of the body. The following measurements will show the proportions :—Length of larva 0·33 mm., length of antennæ 0·27 mm. The antennæ are 8 jointed and have the same appearance as those of the mature larva figured on Plate XVIII, Fig. 2. The abdomen has 10 segments, the last one bearing six long spines about 0·09 mm. in length, they appear to be used for the purpose of keeping in place the fluid excrement which collects in globules on the tip of the abdomen. As soon as the young larva starts feeding the intestines are coloured yellow or green according as to whether the larva is on a pod or leaf. The characteristic red band does not show until a few days after and possibly after the first moult.

FULL GROWN LARVÆ, (Plate XVIII, Fig. 2), as represented enlarged, are about 1·02 mm. long, and their red bands make them conspicuous on a leaf or pod. They carry their abdomens elevated, and if their bodies escape notice the globules at the end of their abdomens will certainly attract attention. The globules of the larvæ

feeding on pods are lighter than those found on leaves. The six spines used in keeping up the globule, are black.

PREPUPA. - In this stage the Thrips does not feed, has the same appearance as the *pupa* figured on Plate XVIII, Fig. 3, with the exception that the antennæ are carried extended to the front and the insects move about a little. Length of this stage about 1·23 mm.

PUPA. (Plate XVIII, Fig. 3).—A female specimen is figured, length about 1.14 mm. The wing cases are seen on the sides extending to the 5th abdominal segment.

HABITS OF THE ADULTS.—After emerging from the pupæ the adult *Thrips* feeds on the under side of a leaf as a rule, but it is sometimes found on the upperside also. It appears to prefer young leaves, and in severe attacks the leaves of young suckers are covered with adult insects. They no doubt oviposit at the same time. Adults walk about on the leaves and when disturbed they raise the end of their abdomens and walk away rapidly. If the disturbance is continued they have a way of jumping, but do not appear to take to flight readily. They appear to fly about in the cool of the afternoon, as I have taken specimens on the wing when walking through Cacao plantations. The males are not often found, and I am inclined to think that they are absent for most part of the year, and that this species is parthenogenetic for several generations in the year. In November and December 1909 a severe outbreak occurred in the Guaico District, and although there was no lack of individuals not a single male in any stage was seen. In November and December last year another search for males was made and this time it was attended with success, males were found about the Town of Port-of-Spain on Cashew and in the country districts of Caparo on Cacao. The proportion was however a very small one. Owing to pressure of work in other directions I was unable to follow up the seasonal history, but I hope to revert to it later on. The adults deposit their eggs on young leaves, but they seem to have a preference for pods of certain varieties of Cacao. The eggs are laid singly, but it was not possible for me to find out the number of eggs a female could lay. The adults seem to have a decided preference for young leaves.

HABITS OF THE LARVÆ.—The larvæ are generally found on certain Cacao pods of the Forastero type and on the older leaves, mostly on the underside of the latter. They are very active when disturbed. In severe attacks they are also found on the young leaves of suckers. They generally remain together in small colonies and will only change when the food supply gives out. Under ordinary circumstances a colony will pass through all its period of development under one leaf without changing place. As mentioned before, when first hatched, the young larvæ are quite colourless, but as soon as they begin feeding the intestines are visible through the accumulation of food particles in them. Excrement is voided in a liquid form and gradually accumulates in a globule held up by the six long spines, at the end of the abdomen, which is carried elevated. After a time the globule becomes too big to be carried about and is then deposited on the leaf or pod where it dries and leaves a small brown

spot. (*See* Plates XIX and XX.) The larvæ appear to prefer the shady side of a pod when it is exposed to the sun. They are quite active when disturbed and it is funny to see them hurrying over the surface of leaves or pods, carrying their globules at the end of the abdomen. If the pod is held against the light the globules can more easily be seen. Skins are changed exposed and among the feeding colony. The number of moults have not yet been ascertained, but they appear to take place several times, judging from the cast skins to be found on the surface of leaves. Hinds* mentions in his Monograph that from two to four moults appear to occur while in the larval stage, the last marking the change to the pupa.

Habits of the Prepupa and Pupa.—When ready to change to prepupæ the larvæ look for some protection such as the web of certain little mites and Psocidæ living on the leaves, but if there is no such protection they remain unprotected on the underside of the leaf huddled together in groups of 10–25 prepupa and pupæ. The prepupæ are a little more active than the pupæ, but both move very little. No food is taken in these stages.

Life History.

In order to study the life history of *Thrips*, I collected Cacao pods that were covered with larvæ and adults, and after washing them off in a gentle stream of water, kept the pods in damp chambers. Three days after young larvæ were observed, 9 days after prepupæ and pupæ were present, and three days later adults appeared making a total period of 12 days from hatching of egg to perfect insect. The pupa stage lasts about 24 hours, and that of pupa 48 hours. Generation seems to be continuous, but during a heavy rainy season the numbers are smaller than in the dry season which appears to be the time most favourable for their development. In the Laboratory I kept *Thrips* on a young Cacao plant from December, 1909, to October, 1910. During the whole period all stages were present.

Natural Enemies.

No natural enemies of any importance have been observed. In one or two localities a small Staphylid beetle was observed among colonies of larvæ. Mites have also been noticed, but none of these were actually seen preying on the larvæ or adults. Mr. D. Moulton in the Bulletin quoted on page 5 refers to a presumably parasitic fungus that occurs on the Pear Thrips in the United States and states that the fungus may prove to be a check for the pear thrips, but its effectiveness is uncertain because it is so subject to climatic conditions. It is possible that we have a similar fungus here, but if not, Mr. Rorer will undertake some experiments with the Pear Thrips fungus when material can be procured.

Control Measures.

Rain appears to exercise some natural control on *Thrips*, there is no doubt that it is not as numerous during rainy weather. With regard to the shade and no shade question as far as *Thrips* is concerned, I have observed that although present in shaded cacao,

* Proceedings U.S. National Museum, Vol. XXVI, No. 1310, page 114.

there are more insects to be found in unshaded or lightly shaded parts of estates. Prevention is better than cure and a thoroughly well cultivated estate is less liable to be attacked than one in poor condition. Two methods of artificial control are mentioned, Fumigation and Spraying. With regard to the former, the following extract * taken from the Government *Gazette* of Grenada for December 31st, 1902, may be of interest to Planters :—"Fumigation by fire of green wood should be continued at the same time (as spraying) and the effect carefully watched. The latter method has much to recommend it on account of its simplicity, and the ease with which it can be carried out by an ordinary labourer. The fires should be set in a careful manner. In making up fires of this nature it should be borne in mind that it is necessary to allow the fire to smoulder only and give off as much smoke as possible. On no account should the flames be given off, otherwise the cacao trees may be scorched and injured. Locally sulphur has been tried as an aid in checking the ravages of Thrips. If applied it is necessary to remember that such application must be carried out with caution, sulphurous acid gas being destructive to vegetation." Personally, I do not think that fumigation carried out in an open field can do much good in killing insects, but above extract is given so as to enable any Planter to try fumigation.

With regard to spraying, attention is called to the kind of machinery to be used. One of the essential conditions to observe in spraying for *Thrips* is that it must be thoroughly done and a pressure of about 150–200 pounds used. Plenty of liquid should be used as the whole tree must be sprayed taking care that the underside of the leaves is thoroughly wetted. It is also necessary that in applying the liquid the nozzle be held close to the leaves of the trees. The machinery recommended consists of any good make of hand pump capable of giving good pressure fitted on to a 10-gallon drum with one or two lines of hose 50 to 100 feet long, to which are attached bamboo extension rods of 10 or 12 feet in length. The best kind of nozzle to use is that of the ring cluster type. In very hilly estates it may not be possible to use a hand pump, and in that case the best substitute would be knapsack sprayers of the Besnard type fitted with bamboo extension rods. Examples of suitable pumps and accessories can be seen at the Experiment Station, St. Clair. As kerosene oil and soap are articles always to be had on every estate or easily procurable, Kerosene Emulsion is the insecticide recommended for the destruction of *Thrips*. It is prepared as follows :—

Kerosene	...	...	2 gallons.
Water	...	...	1 gallon.
Hard Soap	...	...	½ pound.

Shave the soap fine into the water. Put on fire, an empty kerosene tin would do well, and heat until the soap is dissolved. Remove from fire and add kerosene while water is hot; churn with a pump or garden syringe by pumping back into tin or bucket through a fine nozzle until a thick white cream is formed, this will take about

* From *Agricultural News*, Vol. II, page 88.

5–10 minutes. Use rain water when possible. For use dilute one gallon of above mixture in fifteen gallons of water. Agitate the mixture well before applying. Kerosene Emulsion kills by contact and in order to kill insects hatching after the first application it is necessary to spray the same fields ten to twelve days after. Previous to spraying all suckers not required should be cut off and when on the ground thoroughly limed. Kerosene Emulsion costs about one cent a gallon.

Whale oil soap used in the proportion of ½ pound to the gallon of water is also effective, it costs about 5 cents per pound retail.

Scalecide and Nicotine ("Black Leaf 40") may also be used.

The spraying of pods for pod rot appears to keep *Thrips* off, especially if the Bordeaux Mixture sticks well.

Summary.

The Cacao *Thrips* cannot be disregarded as a pest. In certain parts of the Island it appears to be on the increase and does damage occasionally. For this reason it ought to be carefully watched and should it show the least tendency to become troublesome, remedial measures should be carried out at once. *Thrips* does damage very quickly and in favourable weather multiplies rapidly. Large numbers of Cashew trees should not be allowed to grow near Cacao.

I am under great obligations to Mr. P. L. Guppy for the paintings of the 3 plates, which greatly enhance the value of this paper. My thanks are also due to Messrs. J. G. de Gannes and H. Hutton for facilities in visiting estates under their charge.

For further information on *Thrips* some of the following articles may be consulted.

Bibliography.

1. 1898—Broadway, W. E.—*Government Gazette* of Grenada, 1898, No. 139.
2. 1901—Maxwell-Lefroy, H.—Thrips on Cacao trees.—*West Indian Bulletin*, Vol. II, pages 175–180, 2 figs.
   Treatment in Grenada discussed. Cost of Insecticides.
3. 1901—Thrips on Cacao in Guadeloupe.—*West Indian Bulletin*, Vol. II, pages 288–289.
4. 1902—Cacao Thrips—*Government Gazette* of Grenada. Dec. 31.
5. 1903—Thrips on Cacao—*Agricultural News*, Vol. II, page 66.
6. 1904—*Agricultural News*, Vol. III, page 90.
7. 1904—Ballou, H. A.—Extract from report by, *Agricultural News*, Vol. III, page 218
8. 1906—Thrips on Cacao—*Agricultural News*, Vol. V, page 378.
9. 1906—Ballou, H. A.—Cacao Thrips (*Physops rubrocincta*)—*West Indian Bulletin*, Vol. VI, pages 94–99.
10. 1907—Ballou, H. A.—Thrips on Cacao—*West Indian Bulletin*, Vol. VIII, pages 143–147.
11. 1908—Ballou, H. A.—Cacao Thrips—*West Indian Bulletin*, Vol. IX, pages 190–192.
12. 1908—Franklin, Henry James—On a collection of Thysanopterous Insects from Barbados and St. Vincent Islands. Proceedings U. S. National Museum, Vol. XXXIII, No. 1590, pages 715–729, with 3 plates.
13. 1911—Ballou, H. A.—Report on the prevalence of some pests and diseases in the West Indies for the year 1909–10.—*West Indian Bulletin*, Vol. XI, No. 2, pages 85–94.

Prizes offered by the Board of Agriculture for the encouragement of good cultivation of Cacao by Peasant Proprietors and Contractors.

RULES.

1. Prizes will be awarded for good cultivation of Cacao.

2. Only persons owning not more than 16 acres of land to be allowed to compete; the land entered for competition must be in one piece, not divided by other persons property intervening.

3. The prizes to be allotted in two classes:—

CLASS I.—From 5 to 16 acres.

CLASS II.—Not exceeding 5 acres.

4. No person to compete in more than one Class.

5. Prizes will not be awarded unless there are at least 50 competitors in each of the two districts.

6. Prizes to be given in each district as follows:—

	1st Prize.	2nd Prize.	3rd Prize.	4th Prize.	5th Prize.
Class I, above 5 and not exceeding 16 acres ...	$96 00	$72 00	$36 00	$24 00	$12 00
Class II, not exceeding 5 acres	$96 00	$72 00	$36 00	$24 00	$12 00

7. The two centres in which prizes will be offered between January 1st and December, 31st, 1911, will be:

(1.) The Arima and Manzanilla Ward Unions.

(2.) Brasso, Couva and Chaguanas Districts.

8. No proprietor will be allowed to compete in Class I unless he or she has 5 acres in bearing cacao, or in Class II unless he or she has 3 acres in bearing cacao, and no contractor will be allowed to compete who has less than two acres in trees 3 years old.

9. In judging, marks will be given under the following :—

Sanitation of the cacao field ...	Points	20
Treatment of diseases	,,	10
Tillage	,,	35
Pruning (or special treatment of any kind)	,,	10
Crop records	,,	10
General	,,	10
Live Stock	,,	5

10. The method of cultivation and condition of the trees together with circumstances of each cultivation, the characteristics of the locality and the implements used will be considered by the Judges; points may also be given for young cultivation, provided it is in the opinion of the Judges sufficiently advanced to admit of its being judged.

11. The Judges may withhold any or all of the prizes if the cultivations entered for competition are not considered of sufficient merit.

12. Due notice to be given before judging commences, and the decision of the Judges in all cases to be final.

13. Application for entry forms to be made to the :—

Agricultural Inspector at Arima.

Agricultural Inspector, Brasso.

Wardens' Offices at Manzanilla, Arima, Sangre Grande.

Wardens' Offices at Couva, Chaguanas, Montserrat.

Any Post Office in these Districts.

Cacao Estates Accounts.

The method adopted by the Manager, *River* Estate to show a fortnightly abstract of expenditure has received favourable notice from the local planters who have recently inspected the manurial experiments carried on there. The abstract is reproduced here for general information.

CACAO.—*Continued.*

Abstract of Expenditure on "River Estate" for

No. of Hands.		Nature of Expenses.	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Total Week.
				$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
	Staff.	Manager								
		Overseer								
		Overlookers								
		Watchman								
		Stock-keepers								
		Yardman								
	Stock	Supplies for Stock								
		Implements for Stock ...								
		Messengers								
	Cultivation.	Clearing New Lands								
		Line, plant and count Cacao ...								
		Cutlassing Fields								
		Weeding young Cacao ...								
		Draining								
		Round Ridging								
		Forking								
		Manuring								
		Supplying vacancies								
		Pruning Trees								
		Cleaning Trees								
		Filling holes in Trees								
		Burying and liming Shells ...								
		Removal of diseased pods ...								
		Spraying Trees								
		Burning diseased Trees ...								
		Bark and Lop shade								
		Cutting Borders								
		Destroy Ants, Rats, Squirrels ...								
	Manu-facturing	Picking and gathering ...								
		Extract Beans								
		Crooking								
		Dance, dry, fill and sew Bags ...								
		Cartage								
	Maintenance.	Supplies for Estate use, Tools, &c.								
		Roads and Bridges								
		Pasture								
		Clean River and aqueduct ...								
		Whitewashing and clean Buildings								
		Sundries								
		"Reafforestation"								
		Total								

Weather Report.				
Sun.	Sun.	No. of Barrels entered previously ...		
Mon.	Mon.	" " this fortnight ...		
Tues.	Tues.	" " to date. ...		
Wed.	Wed.	No. of Bags made previously ...		
Thurs.	Thurs.	" " this fortnight ...		
Fri.	Fri.	" " to date ...		
Sat.	Sat.	" Bags sold to date ...		
		" Barrels on Estate this fortnight...		

CACAO.—*Continued.*

fortnight ending 19 .

Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Total Week.	Total Fortnight.	Expended Previously.	Expended to Date.
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.

REMARKS ON STOCK.

Mules ... ...

Horses ... ...

Bulls ... ...

Donkeys ... ...

REMARKS ON FORTNIGHT'S WORK.

Manager.

Section III.—COCONUTS.

Coconut Oil Butter and the Preparation of Pure Copra.

By Herbert S. Shrewsbury, F.I.C., Asst. Government Analyst.

Coconut oil butter has come to stay in Great Britain. It is there sold under the name of "nut margarine" or "nut lard" or even (occasionally) as pure fresh dairy butter.

It is rarely that English people find their coconut oil a liquid. In fact one must come to the tropics to realize that the term oil is not a misnomer. On one very hot English summer day in August, 1908, however, when the temperature of the Laboratory was 26·7 degrees C. (80 degrees F.) or 0·8 degrees C. (1·4 degrees F.) higher than the average Trinidad temperature for August 1908, I took observations of the state of some samples I had prepared by mixing measured quantities of margarine fat and coconut oil.

Thus pure margarine was solid and so were mixtures containing 5, 10, and 20 per cents of coconut oil. Mixtures containing 30 and 40 per cents coconut oil were semi-solid and flowed slowly, 50 and 60 per cents were semi-solid and flowed readily, whilst 60, 70, and 80 per cents were turbid liquids flowing very freely.

It is thus on account of its low melting point, rather than because of its rancidity, that this class of butter substitute cannot be used in this Colony. As far as mere rancidity is concerned I should think it would be difficult to prepare a butter substitute which should be worse in that respect than the average sample of butter we enjoy in Trinidad.

Coconut butter, or rather coconut margarine, is always made with a specially purified coconut oil which is quite tasteless and odourless. I have analysed several samples of such purified oil and always found them featureless in these respects. There is nothing objectionable in the taste of coconut margarine when fresh, nor is there anything particularly palatable; it is almost tasteless except when artificial butter flavouring has been freely admixed. It is notorious for the ease with which it becomes rancid, manufacturers always preserving it with ·3 to ·5 per cent. of boric preservative.

The substances which indirectly cause coconut margarine to become rancid are water and curd. They form an excellent medium for the growth of certain bacteria which cause the fat to become rancid.

The prime conditions for superb bacterial growth are moisture, nitrogenous food (*e.g.* milk solids) and a suitable temperature. The last condition varies for different bacteria. These conditions are supplied during the sun-drying of the coconut kernel, since the milk contains suitable nitrogenous food; but the discoloration hardly accounts for the rancidity, though it may be an accompanying feature. Once dried, however, the copra is less liable to the attacks of both bacteria and fungi, as moisture is an indispensable condition of their growth. Preservation by desiccation is one of the principal reasons for drying, another being the obvious necessity of reducing the bulk of water, for purposes of carriage.

Hot-air-drying of the coconut kernels is probably a superior method of preparing copra. At the same time it may be pointed out that Cochin coconut oil is produced from sun-dried copra. Thus Lewkowitsch states in his Chemical Technology of Oil, Fats and Waxes, Vol. II, p. 508: "In India . . . . more refined methods . . . . were resorted to. The nuts were split in halves . . . . the . . . . milk . . . . poured

off and the halves exposed to the sun to dry, when the kernels became readily detachable from the shell. The dried kernels were then triturated and expressed. A still better product was obtained by throwing the pounded kernels into boiling water, when the oil rose to the top, ready to be skimmed off. This process was carried out with special care at Cochin on the coast of Malabar. . . . The reputation of Cochin cocoanut oil for best quality has been maintained to this day." Lewkowitsch also states that "only the most carefully prepared copra will yield an oil that can be used for edible purposes" and that "in the British West Indies drying by means of hot air in a rotary drier has been introduced and the results are considered very satisfactory as thereby the best copra in the market is produced."

It would seem at least questionable if the initiation of a vacuum plant for drying copra is justified by the probabilities of commercial success.

British Market Prices—Coconut Oil.

	January 1911.	*January 1910.*
Cochin, per ton ...	£45	£45
Ceylon, " ...	£41	£42 10

Section IV.—OTHER FRUITS.

Quantitative Experiments on drying unripe Bananas.

Preparation of Dried Unripe Bananas.

Fully developed but unripe bananas were selected for these experiments.

The peel was separated from the pulp by cutting an incision along its length, opening the slit slightly and working it off with the hand—it requires a little practice, but after a short time the peel readily separates, leaving the interior clean.

The peeled banana was then dipped in water to wash off any sap derived from the peel—which would stain it on exposure to air—the centre portion, consisting of undeveloped seeds removed with a brass tube, and the core and remainder sliced transversely with a thin bamboo knife and dried separately in the sun. In bright sunny weather the slices dry in two days. When the slices are thoroughly dry they break with a clean crisp fracture and should be stored in air-tight packages.

The following experiments were made to ascertain the weight of saleable dry slices that could be obtained.

The results show 12·4 per cent. and 14·3 per cent.

If then 100 lbs. of Bananas are taken, only 12 lbs. of dried material will be obtained which at 3 cents per lb. (=£14 per ton) will realise 36 cents. Two fair sized bunches of bananas will weigh about 100 lbs., and each bunch would only realise 18 cents when converted into dried material. It follows that at a price in London of £14 a ton the drying of bananas is not a promising industry so long as green bananas can be shipped and sold at £11 or £12 per ton.

The preserved ripe bananas at £20 to £23 a ton offer more promise of possible success.

DRYING UNRIPE BANANAS.

Results of two quantitative Experiments.

(1.)	Weight of bananas ...	1,362	grammes.	
	Weight of peel only ...	567	,,	= 41·6 % on original.
	Weight of undried pulp ...	795	,,	= 58·3 % ,,
	* Weight of core ...	227	,,	
	Weight of undried slices ...	568	,,	
	Total weight dried core ...	57	,,	= 4·1 % on original [weight of bananas.
	Total weight dried slices ...	170	,,	= 12·4 % † dried material [obtained.
				16·5 %
(2.)	Weight of bananas ...	1,589	grammes.	
	Weight of peel only ...	666	,,	
	Weight of undried pulp ...	923	,,	
	* Weight of undried core ...	226	,,	
	Weight of undried slices ...	697	,,	
	Total weight dried cores ...	71	,,	= 4·46 % on original [weight of bananas.
	Total weight dried slices ...	227	,,	= 14·30 % † dry material [obtained.
				18·76%

A. E. COLLENS.

Dried Bananas wanted.

THE following is a copy of a letter of enquiry from London :—

"With reference to your 1448R/10 of July 8th last, we have pleasure "in sending you the samples of the two classes of dried and preserved "bananas that we require, namely, the ripe preserved fruit which we wish "to buy packed in small boxes 1, 2, and 4 lbs. or more, and the dried chips "in bags of 1–1½ cwt. This latter is the dried unripe banana or plantain.

"It is not necessary for the dried chips to be broken so small; and the "colour of course would be much better than samples; otherwise the meal "would not be so white as we should like.

"The flour we do not propose to entertain, as we can get the dried chips "ground here.

"As to prices, if you think it possible to get the dried chips from £11 "to £14 per ton, and the preserved ripe fruit in small boxes at £20 to £23 "per ton, then we could do a very good business, amounting to many tons "per month."

* The core was removed with a small cork borer and weighed separately so as to prevent discoloration of the slices.

† A previous experiment on a much larger scale gave 13·1 per cent.

Bananas.—Market Prices.

(The Grocer.)

	January 1911. *Per bunch.*		*January 1910.* *Per bunch.*
	6/6 to 14/-		5/6 to 11/-
Jamaica ...	14/-	Bristol	
Canary ...	9/6 to 13/6	,,	
,, (crated)	10/- to 12/6	Cardiff	
Jamaica (crated)	8/6 to 9/-	,,	

Liverpool market.

There is a really good demand for Bananas after the late clearances, and Jamaica fruit is realising 13/6 to 14/- per cwt., Canary Bananas 9/6 to 13/6 per bunch.

Bristol market.

The market is quite bare of bananas, and only 15,000 bunches are consigned this week, so that all merchants will have to take a reduced supply.

Section VI.—RUBBER.

"Caledonia," Tobago,
January 12th, 1911.

Sir,

I herewith beg to submit my report on my recent visit to Mexico and Central America to investigate the conditions of the Castilloa industry there.

I thank the Board for their confidence and trust that the information will be of value.

I am,
Yours faithfully,

HARRY S. SMITH.

Professor P. Carmody,
Director, Board of Agriculture.

The Castilloa Industry in Mexico and Central America.

Report to the Board of Agriculture, Trinidad, read at a meeting held 20th January, 1911.

As suggested in my letter to the Board dated September 16th, 1910, I proceeded to the rubber districts of *Mexico*, viâ *New York*, *Mexico City* and *Vera Cruz*, arriving at the latter place on October 18th. At *New York*, I had the pleasure of meeting Mr. H. C. Pearson the Editor of "The India Rubber World" who gave me valuable information and letters of introduction which greatly helped me in my work. At *Mexico City*, through the courtesy of the British Minister, I was supplied with all credentials to facilitate my travel and investigations.

Proceeding from *Vera Cruz* by "The Heart of the Tropics" Railroad Route to *El Hule*, I soon reached the rubber country. On leaving the train I had a four hour trip up the Papaloápam River, in a small steam launch, reaching *Tuxtepec* after dark.

A RUBBER VILLAGE.

The next morning, I found that *Tuxtepec* was quite a "rubber" village with Castilloa trees planted in everyone's yard, in the way that one sees Coconuts planted in the West Indian villages. *I was pleased to find that these trees were of the same variety of Castilloa as that planted in Tobago, and everything I subsequently saw convinced me that the tree cultivated in Mexico is the same that we have in this Colony.* Many of the trees were very old, and one measured 156 inches in girth, 3 feet from the ground.* These trees are not bled by the owners, but by native tappers who pay a small amount for the privilege. Large V cuts about a foot apart, extending almost round the tree are made with the *machete*, a portion of the bark being cut away to form a rough channel for the latex; and all the trees are chopped from base to the upper branches in this way once a year.

SAN CRISTOBAL DE VEGA ESTATE.

From *Tuxtepec* I wished to visit the *San Cristobal de Vega* estate, a further 35 miles up the river, so I started off next morning with a guide. The road crosses the river six times on the journey, and at the fords, while we were paddled over in a "dug-out" the horses swam across. At each of these fords there are fine clumps of rubber trees, many of very large size, which must have received a certain amount of care from generations of ferrymen; evidently self sown as they were scattered about and range from seedlings, to trees of 120 inches in girth. Notwithstanding the most drastic tapping with the *machete*, most of these trees looked very healthy, but one was sorry to see, here and there, a splendid old tree killed out by this brutal chopping.

Male Castilloa.—It was at one of these fords, that I first saw the *male* Castilloa in flower, and I was surprised to hear later from Mr. J. C. Harvey, (a pioneer Planter and keen botanist) that the greater portion of the plantation trees are non-seed bearing. It is curious to note that it was here, almost on the Northern limit of the rubber zone, that I saw *the largest wild trees*. *Cross* states, "All the wild "Castilloa seen in the forests of *Guatemala* and *Southern Mexico* might "be described as of medium rather than of large size, and of slender habit, "the largest was near *Tapachula*, with an estimated height of 80 feet and a "circumference 84 inches, 5 feet from the ground. There can be no doubt "that in some of the drier districts of the *Isthmus of Tehuantepec* and "Northward, Castilloa shares the reduced size and somewhat stunted growth "of the tropical vegetation, which is here approaching the limit of its "natural range. On the other hand, it can scarcely be doubted, that in the "*more Southern of the Central American Republics*, trees of the Castilloa "attain a size unknown in *Mexico*. Thus, in *Nicaragua*, *Belt* speaks of "trees 5 feet in diameter, which yield as high as 50 lbs. of rubber, when "tapped for the first time." (*U. S. Department of Agriculture Bulletin No. 49.*) Seeing what a fine tree the Castilloa becomes under certain conditions, the wisdom of letting it stand 300 to 1,200 per acre for 8 years is doubtful, and for myself, I would go to the other extreme, and apply Mr. Francis Pears' (Lanadon Estate, Ceylon) views concerning Hevea, to Castilloa. "An acre of rubber with 50 trees is likely to prove more valuable, than one with 200 trees." ("*India Rubber Journal Quarter*

* All girth measurements were taken 3 feet from the ground.

Century Number.) On reaching *San Cristobal de Vega*, I found that the main crop was tobacco, with coffee, rice, and rubber, as minor industries, and the good quality of the samples of rubber sent to London, from this estate, would be due to the fact that 75% of the trees tapped, are old wild ones, and the rest *over 14 years of age.* This estate was only taken over by an English Company about a year ago and beyond planting about 10,000 trees "seed at stake," little has been done.

SAN SAVIARO ESTATE.

Returning to *Tuxtepec*, I was able to visit *San Saviaro*, one of the properties damaged by fire last year.

Fires.—After an abnormally long dry season, the fire started miles away to the Southward, and swept day after day, through the rubber estates of this district. On this estate alone some 83,000 trees were burned; and, although most of these have sprouted from the base again, and made splendid growth, it has been a most serious set back for the Company, who expected to start tapping on a large scale this year.

Now, on all estates in the fire zone, wide traces are kept open, and at the beginning of the dry season are burned off, and kept absolutely clear of all bush or vegetation, &c.

No Shade.—At *San Saviaro*, I first saw rubber which had been planted seed at stake "in the sun," both the 5 month and 17 month fields were looking very well indeed, making a good sturdy growth.

Weeding.—In the early days such fields were kept absolutely clean weeded with the hoe, but it has now been found better, to only clean with the machete, hand-weeding round the young plants, letting the weeds, &c. come up between the rows, only taking care not to let the bush cover the heads of the plants. This custom I found very general throughout Mexico, many of the older fields being cleaned but once a year, just to free the trees from vines and when the trees were being tapped traces were cut and the tappers cleaned round the trees, before putting on the cups, so that the upkeep of an established property is very small indeed.

EL PALMAR ESTATE.

I next went to *El Palmar, Tezonapa*, situated in the most northern rubber district, on the *Atlantic* side. Here the rubber is planted as an auxiliary shade for coffee, and the oldest planted trees are 14 years, but scattered through the extensive pastures are several thousand splendid wild trees.

Tapping.—The tapping here, has been most carefully done from the first, the former owners, (a French company) seem to have gone to a great deal of trouble to teach the Indian tappers, to use a knife with a V shaped blade, in place of the machete. The trees are tapped with *long* V cuts, connected by a shallow vertical channel to carry the latex to a single cup at the base of the tree, and it was most interesting to see the skilful way in which these men, tapping to a height of 30 feet, led the latex down the vertical channel without losing a single drop, even though the tree had a considerable overhang. After making the cut with the V tool it is opened down to the wood with the point of a sharp knife. The men are supplied with a small line, with a weight attached, this they throw over a branch of the tree, afterwards putting a stronger rope over the branch, fitted with a sling in which they sit, pulling themselves up to a height of 30 feet, or more, tying the rope to the sling at each foot, so that they have both hands free to work with.

On every estate that I visited, I found that the tappers worked by themselves, putting on the cups, tapping, and collecting the rubber; and not in gangs as in Tobago, where we have separate people for each

operation. Probably the origin of this method would be, that many of the Indians working on the estates, had been collecting rubber in the forests, many years before its cultivation had been thought of, and when tapping was commenced their methods were adopted.

Seeing that the practice of making long V cuts, (sometimes connected with a vertical channel) is universal throughout *Mexican* estates, I give the following details of some tapping experiments which we made here :—

Tree No. I.—Age 14 years, girth 48 inches, 25 V cuts 16 inches to 18 inches apart connected with a shallow vertical channel. Length of cuts 12 inches to 18 inches. Portion of tree not cut 18 inches. Yield 3 oz. dry rubber.

Tree No. II.—Age 14 years, girth 46 inches, 30 V cuts, 14 inches to 16 inches apart.

Vertical channel.

Length of cuts 16 inches to 18 inches. Portion not cut 16 inches. Yield 3¼ oz. dry rubber.

Mexican Method.—(Long V Cuts.)

Tree No. III.—14 years old, 27½ girth, 6 V cuts 11 inches to 12 inches apart.

Vertical channel.

Length of cuts 11 inches to 12 inches. Portion not cut 7 inches. Yield 1 oz. dry rubber.

Tobago Method.—(Chisel Cuts*.)

Tree No. IV.—Girth 26 inches, age 14 years, 36 cuts with 1½ inch chisel. Yield ¾ oz.

(Trees No. III and IV:) Tapped 6 feet up the tree only.

The last two trees were tapped to compare the chisel system used in Tobago, with the Mexican method. Although the chisel cuts gave 25% less rubber, only 58 inches of bark were incised, against 191 inches excised by the other cutting.

Tree No. V.—Age 8 years. Girth 36 inches. 24 V cuts 15 inches to 16 inches apart.

Vertical connecting channel.

Length of cuts 16 inches to 17 inches, Portion not cut 8 inches to 10 inches. Yield 3½ ounces dry rubber.

Tree No. VI.—Age 8 years. Girth 27 inches. 17 V cuts 14 inches to 15 inches apart.

Vertical channel.

Length of cuts 15 inches to 16 inches. Portion not cut 6 inche to 8 inches. Yield 1 ounce dry rubber

Tree No. VII.—Girth 26 inches. Age 8 years. 17 V cuts 13 inches to 14 inches apart.

Vertical channel.

Length of cuts 11 inches to 12 inches. Portion not cut 6 inches to 8 inches. Yield 1 ounce dry rubber.

Coagulation.—We coagulated this rubber with a solution made from the juice of the "moon vine" (Ipomœa bona nox) without creaming the latex.

Range.—The range of Castilloa seems very great, for at *Cordoba* Lat. 18·50 N. at an elevation of 2,790 feet, I saw two fine trees growing in the beautiful garden of the late Senor Yzguerdo, who had collected a fine selection of plants from all parts of the tropics. These rubber trees were about 30 years old, with a girth of about 60 inches, and bled freely on being cut.

* For description *see* Bulletin No. 66, p. 227.

LA BUENA VENTURA ESTATE.

From *Cordoba*, I had a railroad journey of about 200 miles to *Sanborn*, where I spent a few days on the *La Buena Ventura Estate.* Here we lightly tapped a few 8 year old trees to obtain a sample for comparison by analysis with Tobago rubber, after coagulating with the moon vine, the rubber was cut into narrow pieces and passed several times through a small mangle, making a very strong long strip about 3 inches in width. These strips are tightly wound to make a disc of about 15 inches in diameter, about 10 of these discs bound together by similar strips, when packed in matting and sewn up in an outer cover of bagging, make a good and cheap package for export, two being carried on mule back.

Here we were unfortunate in having two wet days, so I could not see much of the estate. Last year Mr. Harvey tapped 50,000 trees and he was about to start tapping again. He had just returned from a long expedition into the interior of *Campeche.* He kindly gave me a sample of wild rubber collected there.

Cocoa.—Mr. Harvey has also planted a good deal of cocoa, and I was interested to see that 95 per cent. of the trees had quite a different branch system to the trees we have in the West Indies. Looking at a nursery of young plants one would think that the tips of a number of branches had been cut off and planted, these plants *do not fork*, but when the tree is about 4 feet high, it sends out fan-like branches from about a foot below the growing tip, which tend to balance the tree. This peculiar growth continues, and the trunk of a mature tree is *a long way off the perpendicular.*

Given plenty of room this tree does not require much pruning, for it does not throw out suckers; any shoots coming only forming branches. The tree seems of vigorous growth. The pods are moderately thin shelled, shaped like the Criollo. It has a white break.

Mr. Harvey has kept meteorological observations during the last twelve years here which show the following average :—

	Rainfall.	*Temperature.* *Min.*	*Max.*	
January	3 inches	55°	83°	"Northers"
February	2 ,,	55	85	
March	2 ,,	60	88	
April	1 ,,	70	96	
May	0 ,,	76	100	
June	12 ,,	75	90	
July	20 ,,	75	87	
August	18 ,,	76	90	
September	16 ,,	75	90	
October	8 ,,	72	85	
November	5 ,,	60	80	"Northers"
December	3 ,,	58	80	

Note.—The extreme minimum readings are not of frequent occurrence and in records extending over 12 years these phenomenal low readings happen every year about 6 times in the season and are caused by the "Northers," winds which have their origin in the valley of the Saskatchewan sweeping down through the Mississippi valley and thence across the Gulf of Mexico striking obliquely the coast of South-eastern Mexico from the 23rd to 18th parallel North latitude.

THE RUBIO PLANTATION.

About 140 miles on the *National Tehuantepec Railway* brought me to its Atlantic Terminus, *Coatzacoalcos*, where I found that the Manager of the *Rubio* plantation had kindly sent the launch down to meet me.

After an enjoyable journey I reached the estate, which is situated about 40 miles up one of the branches of the *Coatzacoalcos River*. We spent the whole of the next day riding through the cultivation. There are over 2,000,000 trees on this estate, where planting was started in 1902 with a clearing of over 1,500 acres.

SENOR SAENEZ was busy putting up tanks and centrifugal machinery for handling rubber on a large scale and hoped to start tapping in a few weeks.

CHIAPAS.

On returning to *Coatzacoalcos*, I should have liked to have taken the steamer to *Frontera*, *Tobasco*, and gone inland to visit a large group of estates situated in the Department of *Palanque*, *Chiapas*, but as this would have entailed a journey of some hundred miles by river and mule back I could not spare the time. The plantations of this district "*El Chival*" "*Agua Cala*," (belonging to MESSRS. GREVES & GREVES the inventors of the mechanical tapper and patent tapping ladder) "*Lu nija*," "*Wisconsin*," "*Philadelphia*," "*Iowa*," etc., contain many million trees, and with a well distributed rainfall of 100 to 120 inches, and with suitable soil, are said to be doing well. They do not suffer from the strong hot wind which sweeps over so many of the estates on the *Isthmus of Tehuantepec*, and makes it possible for fire to be such a menace, even with a fairly distributed rainfall of 80 inches to 100 inches.

THE ISTHMUS OF TEHUANTEPEC.

On the *Isthmus of Tehuantepec* THOUSANDS OF ACRES OF RUBBER HAVE BEEN PLANTED UNDER UNSUITABLE CONDITIONS, AND ABANDONED, Castilloa will not thrive on a stiff clay soil, or on low lying swampy land; and in many cases where planted on hilly land with shallow soil, owing to the long dry season and strong hot winds, it has died out. With the experience of the last ten or twelve years to help them, planters seldom make any mistake in the selection of land now, and large areas are being opened up each year in a very economical manner, with assured success.

BOGUS SCHEMES.—The effect of this long struggle has also been to weed out bogus schemes, and many people, both in Mexico and the United States, judging only by these failures quite misunderstand the possibilities of Castilloa cultivation.

Many large companies floated during the earlier years of the boom have gone under, as only a very small portion of the capital subscribed ever reached Mexico.

THE LAND OF SAND AND CACTUS.

From *Coatzacoalcos* I crossed the *Isthmus of Tehuantepec*, and during the night passed over the mountainous ridge that separates the *Atlantic* side from the *Pacific*, and at daylight I was in the land of sand and cactus, with a clear dry atmosphere, quite a contrast to the dull misty mornings of the *Atlantic* side, and I travelled fully 200 miles by the *Pan-American Railroad* before again running into the rubber belt.

EL ROSERIO ESTATE.

On reaching *Mapastepec* in the *Tonola Department of Chiapas*, I visited *El Roserio* a young estate, which, at the end of 1911 will have 5,000 acres under rubber, all planted in 3 years.

METHOD OF PLANTING.—A very good example of the method of planting now generally adopted in *Mexico*, viz., close planting seed at stake "in the sun"—the outcome of many years experience and observation. In the early years of rubber cultivation in *Mexico* the original forest

was often thinned out and seedling rubbers planted in this partial shade, they were however, found to grow very slowly, while it was noticed that nurseries made right out in the open, gave a very rapid sturdy growth.

I believe it was at *La Zacualpa* that the first plantings on a large scale under this system were made, this was at a time when there was difficulty in obtaining a large quantity of seed and only one or two could be put at each stake, with the result that large areas were absolutely cleaned out by rats, lizards, birds, &c., until after trying all sorts of things, it was found that if the seeds were first steeped in garlic, nothing would touch them.

Under this system the land is cleaned, burned and staked 6 x 6, 9 x 9, 6 x 12, 5 x 10 according to the fancy of the planter and is ready for "seeding" at the end of the dry season, with the first rains in April about 10 seeds are planted at each stake.

At the first weeding about two months later, some of the weaker plants are thinned out, and at each subsequent cleaning this continues, so that at the end of the second year only one plant remains at each stake, the finest from ten seedlings.

In theory, this thinning out goes on year by year, as the trees interlock, but for various reasons they are not cut out, *and one sees trees 8 years old standing 1,200 to the acre, on some estates.*

This system of planting gives splendid results *in the first two years,* as is shown by the remarkable growth at "*El Roserio*" where some of the 5 month seedlings are 4 feet 9 inches in height and the 17 month trees, 17ft. 8in. in height with a girth of more than a foot. Notwithstanding this rapid early growth, trees of from 6 to 8 years old do not on an average, exceed ours in girth, and nowhere in *Mexico* did I see trees age for age to equal those which we have, wide planted as a shade for cocoa, intermixed with *Immortelle.* And I believe that Dr. Paul Preuss is quite right when he states "A certain amount of shade afforded by planting suitable trees appears to me to be necessary for Castilloa, if the tree is not to become poor and impoverished"—(*India Rubber Journal Quarter Century Number.*)

Soil.—The soil on the *Chiapas* Coastal plain is a very deep friable one, and on digging a well here, at 15 feet, the subsoil was a dark coarse sand, with no sign of rock or clay, water is always found near the surface, some Planters attribute the fact that the rubber stands a long absolutely dry season to the good capillary action of this soil. In confirmation of this theory, I noticed that in *Salvador*, only a few miles from the edge of the coastal plain, on low undulating lands, under exactly the same climatic condition, one did not see a single rubber tree.

DOÑA MARIA ESTATE, SOCONUSCO.

My next visit was to *Doña Maria, Soconusco.* This estate with about 1,800 acres under rubber, and with the greater part at a producing age, has recently been taken over by an English Company. The early plantings were made under rather heavy shade.

Tapping.—Tapping was in full swing, V cuts extending ¾ round the tree, without the vertical channel, being the system used.

Daily Task.—The daily task was 10 *litres* of latex per man. A bell is rung at 3 a.m. to wake the women, they prepare food for the men, who muster at 4 o'clock and proceed to the field. At the first glimpse of daylight they start work, seldom tapping after 10 o'clock as they find, even in the wet season the trees do not flow freely after this time. The "*Smith*"

knife is used, which makes a semicircular groove in the bark, the knife is then turned, and with a knife blade fitted on this side, the cut is opened to the wood. The men are very skilful, and the tapping is done very quickly. Light ladders are used, which fit into each other, so that for the upper cuts two ladders can be used and the tree cut to a height of 15 to 20 feet.

COAGULATION.—The rubber is coagulated with the juice of the "moon vine." The latex, on being brought in, is passed through a double sieve made of fine copper gauze, it is put into wooden tanks and diluted with water 5 to 1. The next morning the water is drawn off from below and clean water added; in the afternoon the water is again changed, and a solution made by crushing the stems of the "Moon Vine" is added (about 1½ lbs. of stems to 5 gallons of latex). The third morning the semi-coagulated mass is gently patted down while floating on the surface of the water, and with a little working, the slab can be lifted out of the tank, it is then cut into thin slabs and passed through and through the rolls of a small cane mill with water flowing over it all the time.

DRYING.—After drying *for about a week* it is blocked in a simple wooden press and shipped in an *uncured* state.

MACHINERY.—An engineer from England was superintending the erection of a modern plant, crêpeing and sheeting rolls, vacuum drying stove, hydraulic press, &c. for handling rubber on a large scale.

A SURFACE FEEDER.—With the deep, rich, well drained soil of the *Chiapas* plain I thought that the Castilloa tree might have become a deep feeder, but I was able to get a photograph and measurements of the root system of a large dead tree which shows that even under these conditions it is *essentially a surface feeder.*

THE MILK DUCTS.—I also obtained from this tree, a specimen where the rubber, solidified in the milk ducts, had made a perfect cast of the laticiferous system, similar to that mentioned by Hart (Bulletin of Miscellaneous Information No. 45, Trinidad).

THE LA ZACUALPA GROUP.

The last place I visited in *Mexico* was the *La Zacualpa* group, consisting of "*La Zacualpa* No. 1", "*La Zacualpa* No. 2", "*Juilapa*" and "*Los Tocoys.*" All under one management, which with 20,000 acres under rubber, and 6,000,000 trees, forms the largest block of Castilloa in the world.

OUTPUT.—The output for 1910 exceeded 100,000 lbs. and within 3 years the annual output will reach 500,000 lbs.

FOUR YEARS OLD.—After making experimental tappings of young trees and carefully watching the results, Mr. FISHER, the manager, has decided that trees *as young as 4 years old* can be tapped to advantage, and without injury, provided they are 15 inches in girth.

These young trees are only tapped to about a height of six feet with 4 or 5 V cuts, each year as the trees expand the cuts are carried higher up the trunk, so that at ten years there may be about 20 to 25 cuts reaching 30 feet up the tree.

COLLECTION.—Various systems of collection have been tried, tapping by day's work, by a task of a given number of trees, payment by fluid measure of latex brought in, &c., &c., but Mr. FISHER has now introduced a plan which has proved very satisfactory and nearly doubled the amount brought in by the same number of tappers.

RUBBER.—*Continued.*

Each man has a number in the "Mill Book" his collecting bucket and coagulating tanks have a similar number, at present there are 240 wooden tanks, in groups of six, each man's number corresponds to 3 of these, so that the latex brought in on Monday goes into one, Tuesday's into a second, and Wednesday's into a third. Monday's latex being coagulated on Wednesday, leaves the first tank ready for Thursday's rubber, each tank is fitted with a tap to draw off the water from the bottom and a glass covered slit to show when enough water has been drawn off, and each group of 6 has a jet above for filling the tanks with fresh water. When the rubber is coagulated on the third day, it is lifted out of the tank, and a number tag stuck into it; it is taken to the crêpeing machine, the rubber passes through the rolls, and with its tag goes on to the weighing machine where the amount is noted against the man's number in the "Mill Book."

The daily task.—Under this system, tapping in a 7 to 8 year field, with wild rubber scattered through, 77 men tapped 4,015 trees on one of the days that I was at La Zacualpa, bringing in enough latex to make 528 lbs. of dry rubber = *52 trees per man*, with an average amount of *6·9 lbs. per man.* The greatest amount brought in by one man being 9¼ lbs. A man who takes a small boy with him brought in 12 lbs. Tapping 12 days during two weeks, these two brought enough latex to make 189 lbs. of dry rubber. On the day that I took my notes 506 lbs. passed through the crêpeing rolls, 18 lbs. through the centrifugal, and 4 lbs. of scrap from the tins, buckets, tanks, &c., making in all 528 lbs. from 4,015 trees=2·2 oz. per tree. The men have to bring in 5 lbs. per day and are paid 3d. for every extra pound. If after a short trial they cannot do this they are put to other employment.

Centrifugal Machine.—Here all the water which is drawn from the coagulating tanks during the washing process, runs into large tanks, and is passed through an "Empire" centrifugal machine, which works on the principle of the milk separator, but instead of discharging the rubber in a fluid state it coagulates it in the bowl. When the bowl is full the machine is stopped and the block lifted out and put on a peg to drain, and afterwards cut up into inch slabs and passed through the crêpeing rolls.

The centrifugal rubber realizes about 4½d. per lb. more than the crêpe. The makers say that the latex should be diluted to 1% rubber solids and recommend that it should stand 36 to 48 hours before being run through the machine.

Drying and Pressing.—The rubber is put in the drying room for about a week, and afterwards pressed. The shipping boxes fit tightly into a strong wooden press, 50 lbs. of rubber is packed and pressed for a time, then a frame the size of the box is put in the press above the box, and a further 50 lbs. packed, and the whole amount pressed level with the top of the box, and the lid nailed on before the rubber expands.

Rainfall.—Through the kindness of Mr. Fisher I was able to obtain the following data.

Average rainfall for the last eight years at *La Zacualpa* No. 1. 70 inches, with a range of 60 to 89 inches, November to March being practically rainless.

At *Juilapa* only 12 miles away on the "Foot hills," elevation 500 to 600 feet, the average rainfall of the last 4 years was 121 inches, with a range of 109 to 127 inches, with 4 dry months.

In the *Coffee Zone* only 30 miles inland the average rainfall exceeds 200 inches.

At *La Zacualpa* even in the wet season the mornings are usually fine, and tapping is done during ten months of the year. During February

and March the latex does not run freely, so the trees are rested until the rains set in in April.

FIRES.—In the dry season every precaution is taken to prevent fire, which is a most serious danger and has caused much loss.

From *La Zacualpa* I proceeded to *Tapachula* and *San Benito*, where I embarked for Panama on November the 27th after spending a most interesting six weeks in Mexico.

I should like to express my keen appreciation of the great kindness and hospitality shown me in every case, and to the truly friendly spirit in which all information was given.

GUATEMALA.

In *Guatemala* on the railroad from *San José* to *Guatemala City*, I saw both wild and cultivated Castilloa, and it was interesting to note, that on reaching an elevation of about 1,200 feet, one had run out of the natural rubber zone in this district.

PANAMA.

On reaching *Panama*, I found that the Castilloa tree under cultivation was a different variety to the one planted in *Mexico*, *Trinidad* and *Tobago*.

A DIFFERENT VARIETY.—There are a number of mature trees said to be about 25 years old in the grounds of the *Ancon Hospital*, which were planted by the French when they were working at the canal, and from the general growth, both here, and in the other districts of *Panama*, it would seem to be a smaller variety, *and it is the exception* to see the branches spread out almost horizontally, which is so characteristic of the Mexican tree.

The latex of this variety *does not flow freely at any time*, and on the tree being tapped it oozes out and quickly thickens, and has to be scraped off or left to coagulate as scrap. I noticed plantation trees of about 20 years old that had been repeatedly tapped, knowing that the latex would not run down, the cuts had been made horizontally, with no attempt to centralize it. A native tapper told me that the wild trees give a more fluid latex, but even these trees do not run freely, the greater amount being collected as scrap, the little reaching the ground being collected on leaves spread to catch it.

SEEDING.—The Castilloas were in flower when I was in *Panama*, out of about 30 trees I could only find 2 female trees. This question of seeding has puzzled me and I should be glad of any information bearing on this point. In Tobago, I have never seen a male Castilloa, the male and female flower appearing on the same branch. COOKE states : "Both usually occur on the same tree though young trees often produce the male or staminate flowers."—(*U.S.A. Bulletin, No. 49*). Both at *Tuxtepec* and *Tapachula* although it was not the general seeding time, I saw several large wild male trees in flower.

Trimen states: "The Castilloa trees at *Paradeniya* and *Henaratgoda* produced flowers during the dry season; on examination however, these proved to be males."—(*Report of the Director of the Royal Botanic Gardens Ceylon, 1881.*)

Trimen states:—"We had occasion to cut down a tree at Paradeniya—a healthy male specimen which had been planted as a cutting in 1882 and had a circumference of stem about 3 ft. 7 in."—(*Report of the Director of the Botanic Gardens, Ceylon, 1888.*)

The original Ceylon plants came from near *Gatun*, *Panama*.

THE LABOUR QUESTION.

In several of the rubber districts there is a scarcity of labour. The practice of making a large advance to each labourer is very general, by this, they are bound to the estates being content to work out the advance and then obtaining another they go off for a time to their village in the mountains and it is quite the exception if they do not come back and fulfil their engagement. Should a man transfer to another estate the new manager has to give him an advance to clear his indebtedness to his former employer.

The pay is from 30/- to 50/- per month of thirty working days with food and quarters, which makes the average rate 2/- per day. The hours are long practically from dawn to dark. On Sundays they work 3 hours for their food.

On a few estates Government contract labourers are employed *i.e.* men under sentence of imprisonment. These men are fed and paid 1/- per day. They work under armed drivers and are locked up at night.

There are regular labour contractors who will undertake to provide men and superintend any estate work from cleaning a ten acre field to felling and planting a 2,000 acres block.

DISEASES.

On the whole, the Castilloa tree in *Mexico* is singularly free from disease. I did not see a single case of "Collar rot" which attacks it in the West Indies.

"Die back" is fairly common in some places, but where it is not due to actual poverty of soil or to the effect of strong drying winds, it has been found to be amenable to treatment.

One large area was pointed out to me, where by cutting 3 feet drains every 36 feet, an apparently hopeless piece had been brought into splendid condition. And where the soil had been baked and the roots injured by hoe weeding, by simply letting everything grow up for two years to shade the ground and trunks a complete recovery was made.

Canker will have to be most carefully watched on the *Atlantic* side with its humid climate. In certain districts I saw fine trees killed by it; but the long dry spell of the *Pacific* slope seems to keep it in check. Even here there was serious damage, but I did not see trees actually killed.

YIELD.

The yield of Castilloa would seem to be about the same in the West Indies as in Mexico.

At San Cristobal de Vega a large wild tree gave 12 lbs. of dry rubber in two tappings during the year.

At *La Zacualpa* one plantation tree 20 years old gave 2 lbs. 10 oz. at a tapping.

In the West Indies the following yields are on record:—

Richmond estate, Tobago, a tree 17 years old gave 1 lb. 10 oz. tapped twice during the year.—West Indian Bulletin, Vol. VI, No. 2.

Botanic Station, St. Lucia, a tree 17 years old gave 2 lbs. 10 oz. at a tapping.—West India Bulletin, Vol. VII, No. 1.

Tobago tree, first 6 feet tapped with chisel. St. Lucia tree, 12 feet tapped with 53 V cuts, each separate cut being about 4 inches in length. The Mexican trees were tapped with large V cuts extending almost round the tree about a foot apart.

Although selected trees give these good results one could not judge the average returns of an estate on these figures, as will be seen by the following:—

Mexico.

400,000 gave 4 oz. tapped 3 times during the year.

Age 4 to 20 with scattered wild trees in cultivation.

Tapped right up the trunk.

Age 6–8—	50,000	gave	1 oz.
6–7—	858	,,	1·2 oz.
6–7—	1,175	,,	·85 ,,
7–8—	4,015	,,	2·2 ,,

Single tapping, trees tapped high with ladders.

Tobago.

24,000 gave $2\frac{1}{3}$ ozs. tapped 3 times during year.

Age 10 to 12, tapped only 6 feet up trunk.

Age 8–12—	3,000	gave	1 oz.
6–8 —	1,300	,,	1 ,,
10–15—	750	,,	1·5 oz.

Single tapping also first tapping which is found to give a little more than regularly tapped trees. 6 feet of trunk only tapped.

The Tobago trees are wider planted than the Mexican but there are of course no wild trees to bring up the average.

At *La Zacualpa* No. 1, about 400,000 trees were tapped during 1910 with an output of about 100,000 lbs. an average of 4 ounces per tree. During 1907–08, the average was $7\frac{1}{2}$ ounces per tree. This apparent set back is easily explained, during 1907–08, only trees of 7 years and over were tapped; now it has been found that 4 year old trees can be tapped to advantage, greatly increasing the total out put while reducing the average per tree.

Even with this small average yield the gross return for rubber exceeded £20,000 during 1910 and this with only one-fifteenth of the trees producing.

On this estate a block of several thousand trees 20 years old have given an average yield of 2 lbs. 4 oz. during the last year, tapped three times. This is most encouraging as the results are from a number of trees.

It is only fair to say that Planters I have met are in no way responsible for such statements as that made by Mr. Ashmore Russan:—

"As regards the production of the Castilloa compared with that of the Para rubber tree, the scale which may be counted upon in *Soconusco* is as follows:—

Age years	6,	7,	8,	9,	10,	11,	12.
Yield lbs.	$\frac{1}{2}$,	$\frac{3}{4}$,	1,	$1\frac{1}{4}$,	$1\frac{1}{2}$,	$1\frac{3}{4}$,	2.

Four-years-old trees have sometimes been tapped but the rubber from such young trees is very resinous."—*India Rubber Journal Quarter Century Number.*

They regret such misleading estimates and would much rather the industry were judged by actual results.

The above yields would not seem to give much encouragement to planting Castilloa if early returns are looked for, but I am still of the opinion that it is the tree most suited to local conditions, it is hardy, on suitable soil it grows very readily and when 3 years old it practically takes care of itself.

It is harvested cheaply being only tapped three or four times a year, it takes long to mature but as the yield and quality improve, the cost of collection becomes less and the Castilloa that we have in the West Indies should eventually prove one of our most remunerative assets.

Hevea on the other hand, has proved in Tobago, a much more delicate tree, requiring more labour both in its cultivation and tapping and with the high rate of wages ruling would not appear to have such a satisfactory outlook.

MARKET PRICES.

Through the kindness of Mr. PEARSON I met several of the New York rubber brokers and on comparing notes, as to prices, &c., they thought that London rates for cured plantation Castilloa might range a little higher than the New York prices, probably due to the large amount of "Para plantations" handled there. All Mexican Plantation rubber reaches New York in an uncured state, mostly pressed sheet or pressed crêpe and of a dark colour.

Mexican wild rubber sheet or slab always fetches a lower price than Mexican wild scrap owing to the way the natives adulterate the slab.

CONCLUSIONS.

As a result of my visit I think that the following conclusions may be drawn :—

(*a.*) That we have the same variety of Castilloa as that cultivated in Mexico, where it has been proved that its culture can be made a commercial success.

(*b.*) That the general conditions, climatic and economic, are equally favourable in this Colony.

(*c.*) That from actual experiments, and from information given by planters in Mexico, there is nothing to justify the statements made that ten to twelve year old Castilloa trees yield an average of about 2 pounds per year, but everything shows that the average at this age is nearer ½ lb. per tree.

(*d.*) That by tapping higher up the tree as is done in Mexico *our yield can be considerably increased* and that by adopting some modification of the Mexican methods of tapping and collecting, *our cost of production can be reduced materially.*

(*e.*) That the percentage of resin in rubber from trees of similar age is probably the same in both places, but the resin-contents of the average rubber shipped from Mexico would be lower, on account of the number of large wild Castilloas scattered through the plantations, which are tapped at the same time as the young cultivated trees and the latex mixed.

HARRY S. SMITH.

Castilloa Tree—Results of Tapping.

A LARGE Castilloa tree was known to have flourished in the Emperor Valley which lies on the outskirts of the Botanic Station. Recently its position has been located, and as it is a large tree and had not been tapped for several years an experiment was made for the purpose of ascertaining what yield of rubber could be obtained from a tree of that size and age. It is satisfactory to find that in Trinidad a Castilloa tree can give a yield of over three pounds of rubber at one tapping.

About this tree Mr. Broadway supplies the following particulars :—

—"As verbally requested I give you what I know about the largest tree "of *Castilloa elastica* in Emperor Valley of Government House Gardens.

"This must have been planted in Mr. Prestoe's time who had charge of "the Botanic Gardens previous to Mr. J. H. Hart's arrival in the Colony in "the year 1887, for I have known it myself during the past twenty two "years and from its size it must have been several years old then. I would "therefore place the tree, approximately, at the age of 30 years. From the "old scars it shows that tapping has been carried out on previous occasions.

"Two photographs of the tree were taken on the 6th February. During "the same day, before breakfast, the tree was bled in the presence of your- "self, Mr. Norman Lamont, Mr. A. E. Collens and myself. The next tap- "ping was finished up to a height of 40 feet by Mr. Feilden, the Acting "Curator, and Domingo.

"Circumference at base of trunk ... 9 feet.
" " six feet above ground 7 "

"The latex and sciap were sent to the Laboratory to Mr. Collens.

"The bleeding was carried out on the "Smith" system of chisel cuts "right around the body of the tree with cuts one foot apart vertically."

The rubber has been separated and weighed by Mr. A. E. Collens who reports :—

RUBBER RETURNS—LARGE CASTILLOA TREE EMPEROR VALLEY.

Tree tapped on 6th and 8th February.

Registered Latex ...	...	2,400 cc.	
			Weighed on 15th.
Scrap recovered from tree	...	...	832 g.
Prepared at Laboratory.			
2 Biscuits ...	...	134 g.	
1 Sheet	...	457 "	
Scrap	...	25 "	
			616 g.
			1,448 g.
			=51·07 ozs.
			3 lbs. 3·07 ozs.

A. E. COLLENS.

Tapping Para Trees—Experiment Station.

PROGRESS REPORT.

THE following are the results obtained to date from six trees tapped on alternate days :—

			Yield of Rubber per tree.	
1910—September	12th to 30th	...	3·89 ozs.	
October	1st " 31st	...	6·57 "	
November	1st " 30th	...	4·89 "	
December	1st " 15th	...	3·16 "	
December	16th " 31st	...	4·07 "	(5 trees *)
January	1st " 31st	...	8·26 "	"

* No. 5 ceased to give latex.

The variation in yield is considerable as the following figures show: —

12TH SEPTEMBER, 1910 TO 31ST JANUARY, 1911.

Tree.	*Yield in Latex.*	*Estimated yield in rubber.*
No. 1	... 3,427 cc.	... 42·35 ozs.
,, 2	... 3,764	... 44·84 ,,
,, 3	... 3,617	... 44·77 ,,
,, 4	... 1,061	... 12·91 ,,
,, 5	... 653	... 8·04 ,,
,, 6	... 1,577	... 19·36 ,,

The Castilloa Tapping Prize.

THERE is no reason why some of our local Planters should not try to secure this Prize. Many of them have had personal experience in various modes of tapping, and tapping instruments.

THE "INDIA RUBBER WORLD" (NEW YORK) TROPHY.

"This trophy of silver is a cup fifty inches in height, and is of most "artistic design and workmanship. The stem of the cup represents a trunk "of the *Castilloa elastica*, beside which is depicted a man with a rubber-"tapping knife in one hand and a calabash in the other, tapping the tree "in the destructive manner common to wild-rubber gatherers. The upper "part of the tree trunk terminates in a cluster of *Castilloa elastica* leaves, "which holds a vase graceful in form, the centre panel bearing the "inscription:

"The India Rubber World Trophy, for the Best System of Extracting Latex from the *Castilloa elastica*. International Rubber Exhibition, London, 1911."

"The middle of the border, at the top, shows a raised hemisphere of "the countries in which the *Castilloa elastica* thrives. On each side is a "frieze of planted Castilloas. The Trophy, in American butler and French "grey style, represents a value of $1,000, and the well-known silversmiths "Dieges and Clust, New York, are the makers.

"The cup is offered specifically for the solution of the *Castilloa elastica* "problem. It is well to remember however, that if this is satisfactorily "solved, a new value will be placed upon the sapiums, funtumia, ficus, "gutta perchas of all kinds, including jelutong, as well as the *Castilloa* "*elastica* ulei."

CONDITIONS OF THE COMPETITION.

(1.) The award is to be made for the best process, method, tool, or appliance, for extracting the maximum amount of latex from the Castilloa elastica, without permanent injury to the tree.

(2.) There will be no entrance fee.

(3.) Entries may be tools or appliances, together with full description, or drawings accompanied by descriptions.

(4.) Tools, appliances, or drawings submitted for competition will be assembled as one exhibit, known as the India Rubber World Competition.

(5.) The cup will be the absolute property of the successful contestant. It will be presented to the winner (or his accredited representative) at the International Rubber Exhibition Dinner, to be held in London while the Exhibition is in progress.

(6.) The judges have the right to test every tool or appliance.

(7.) Tools, appliances and drawings will be returned to the owners or representatives at the close of the Exhibition.

(8.) While the management of the Exhibition will scrupulously protect the exhibits, they will not be responsible for any loss or damage from any cause.

(9.) The judges' decision shall be final, and entries will only be accepted on this understanding.

(10.) All entries must be made to the Awards Committee, International Rubber and Allied Trades Exhibition, Ltd., 75, Chancery Lane, London, W.C., by Monday night, May 1, 1911. Letters bearing postmark May 1 will be accepted as entered at the offices on that date. Entries should be sent by registered post, or delivered by hand, so that a receipt may be given for them. Exhibits for competition must be sent direct to the Awards Committee, Royal Agricultural Hall, Islington, London, N., but should not reach that building before June 15, and not later than June 20. Transportation must be paid on all exhibits.

The Exhibition opens June 24th, and closes July 11th, 1911.

(Circular from Organising Manager.)

Para Rubber—Fluctuations in Prices.

	Fine Para Rubber.				Cultivated.			
	1910.	1909.	1908.	1907.	1910.	1909.	1908.	1907.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Opening Price ...	7 7½	5 1½	3 5¼	5 2¾	7 6	5 4	3 10	5 6½
Closing ,, ...	5 6½	7 7	5 2	3 5¼	5 5½	7 9	5 4¼	3 10
Highest ,, ...	12 6	9 2½	5 4¼	5 3¼	12 8½	9 7	5 9½	5 9¼
Lowest ,, ...	5 6½	5 1	2 9	3 3¾	5 5½	5 4	3 0	3 9

Para Plants—Local Distribution.

A distribution of the small number of plants produced from the seeds imported from Malay has been made to different parts of the Colony. In this way, it is hoped, that the most suitable soils for Para will be ascertained.

Preparing and Clearing for Hevea Brasiliensis.

In speaking of a 'clearing' one has in mind an area of stripped jungle such as is to be met with in the Mid-East, where the mass of alienated Para rubber is located. This work is most economically performed by contract, and the cost, which should include roading and draining ought never to exceed 30 Rs. (£2) per acre. Operations are usually commenced in the dry season, so that the cleared land may be ready for planting during the rainy period that follows. Perhaps the most serious problem present-day planters are faced with in this connection is that of the distance at which the trees should stand. It is a problem which for the last seven years has caused more controversy than any other question associated with the industry, and it is as burning a topic in the tropical bungalows to-day

as ever it was, with never a sign of agreement in sight. The reason is not far to seek, and if there be any call to frame a complaint in the matter, it should be laid at the doors of the Kew authorities themselves, since they and they alone were responsible for the cultural policy associated with the introduction of the rubber tree into the Mid-East. But I am one of those who do not admit that there is blame to lay at anybody's door, because I regard the whole question of "close versus wide planting" as a more or less manufactured bogey. On the one hand we are warned against placing Para trees at distances less than 30 feet each way, since at these intervals fungoid and other disease pests have less chance of contaminating, the roots have freer play, and the branches more elbow-room. Well, I have seen plantations set out on this scale, and I have the proprietor's authority to say that he is in perfect sympathy with me when I describe these trees as a disgrace to their kind and as the greatest botanical frauds that ever burdened a plantation. On the other hand, not many miles further I saw a plantation of fifteen-year-old Para trees standing 8 feet by 10 feet, tall, straight, and well boled, the most beautiful things the eye of a rubber man might behold, and I was not at all surprised to learn from the visiting agent that these trees gave over 9 lb. of dry rubber per year on the quarter half-herring-bone system of tapping.

What, then, is all this quarelling about? Can anyone but the planter himself decide the question? For instance, take the case of our friend who has occasion to hourly curse the genius who persuaded him to plant his trees 30 feet apart. The land here lies on two hill slopes, the openings of which provide perfect pockets for every gust of wind which comes that way, with the result that for every day during the prevalence of the South-west monsoons these poor trees are swept by the wickedest little toy-cyclones imaginable, whilst during the North-east monsoons, through the vagaries of the opening at the other end of the range, this unfortunate plantation is deprived of fully 25 per cent. of its allotted rainfall, and the rubber only exists on sufferance in consequence.

I was able to convince my friend that in Brazil the seringueiro is not troubled in this respect with the torments of distances, for the *Hevea brasiliensis* although found but two to ten to the acre, is yet invariably so crowded on all sides by forest giants and undergrowths that it is often very difficult to obtain an adequate basal tapping of the tree. He has accordingly decided to carry out my suggestions—first, to blot out the wind scourge by planting up Darien Castilloa 20 deep across these openings, and then to fill up the intervals of the old plantation so that the trees are nearly as possible 15 feet by 10 feet in the plantation. Let me at once say that to my mind this is the ideal distance at which Hevea brasiliensis should stand on sloping wind-swept ground. Where, however, the land is flat and sheltered they should be planted 20 feet apart each way. The Hevea cannot tolerate the wind. Under its influences the plant becomes stubborn, and refuses to grow save in a fantastic fashion all its own, and in a manner inimical to any chance of its ever becoming a profitable tree. Hence the first principle in successful cultivation is the prevention of any wind exposure and the planting of the tree at distances in conformity with the lie of the land. This work should be undertaken as soon as the contractor can hand over the ground as it is cleared.

We begin by staking out the plantation with white-painted "stubs" or sticks, which are placed just where the trees would stand, and always in an easterly by westerly direction. "Holing" is the next operation. This consists of the removal of a circle of earth around the mark stake at a diameter of 18 inches and a depth of 9 inches. The soil is well pulverised, and where the seed is raised direct and "sowing to stake" methods

are in operation, the soil is replaced and the seed put 2½ inches deep, germination taking place generally in about 20 days. If "stumps" are used the shortened saplings – for such are stumps,—are placed in the hole, the tap-root being allowed to lie in a narrow funnel of earth, so that the tender surface-feeding rootlets rest evenly 6 inches from the surface, the soil of which must be well pressed down without unduly cramping the young plant.

When the plantation has received the final touches at the hands of the contractor, and the seed, or the saplings, placed in position, it is then that the planter must exercise the greatest and most careful supervision in order to provide against animal and insect ravages, and the dangers arising from abnormal growth of the rank weed and grasses that are always on hand ready to battle out the problem of existence with cultivated rubber. It is a good plan to weed around the plants at a diameter of 6 feet every month and to cut down every two months all other growth and lay it as top mulch over the roots of growing trees Nothing benefits the plants so much as this treatment. At the end of the season the trees should be of a stature sufficient to enable them to take care of themselves for the next three months, when they will have attained an age of one year. This is the period when the proprietor should go carefully over his plantation and condemn out of hand all trees that have failed to "bole" or that show inclination to branch near the ground. These must be destroyed, together with any that exhibit signs of insect or fungoid ravages, and the whole burnt straight-away.

When the trees are eighteen months old they may be manured lightly with a mixture of lime, castor cake and basic slag, which should be dusted by hand over the whole line of rubber represented by a 3 feet boundary of each side of the tree. This should be repeated every six months until the trees are 3½ years old, when they may safely be asked to live the remaining year of a playtime existence in a loyal endeavour to rejoice the heart of the patient planter when first he applies the knife at the experimental tapping stage.—*(The Rubber World.)*

Rubber in Mexico.

In Mexico india rubber is obtained from two different plants, *Guayule* in the north of the Republic, and *Castilloa elastica* in the South. The total export of rubber from Mexico in the fiscal year 1908–1909 amounted to 6,015,173 kilos. (13,261,000 lb.), with a declared value of £850,661, the respective proportions of Guayule and Castilloa being 5,601,858 kilos (12,348,800 lb.), and 413,315 kilos (911,200 lb.), or 93·12 and 6·88 per cent. It is stated that expectations with respect to the Castilloa tree are far from being fulfilled. In Palenque there are well developed 14 year old trees yielding no latex, whilst in the Isthmus 7 or 8 year old trees in normal condition give 90 to 120 grms. (3·2—3·5 oz.) per year. The most promising Castilloa plantation has an area of 500 hectares (1,235 acres) with 350,000 trees 6 to 8 years old yielding 36,800 kilos. (81,130 lb.), of commercial raw rubber, which corresponds to 73·6 kilos per hectare (65·7 lb. per acre), and 105 grms. (3·7 oz.), for each tree. It is difficult to estimate the extent of the Castilloa cultivated in Mexico, but the total area according to the most reliable estimates for the Palenque, Tabasco, Veracruz, and Soconusco districts amounts to 36,000 hectares (88,920 acres). Taking the yield for a 10 year old plant as 150 grms. (5·3 oz.), and assuming that there are 500 trees per hectare (200 per acre), then the yield of plantation rubber in the year 1915, given favourable weather conditions, may be estimated at 2,700,000 kilos. (5,952,400 lb.).—H. J. Ludewig, in *Tropenpflanzer.*

Section VII.—CEREALS & STARCHES.

Soya Bean.

SAMPLES of the following varieties of Soya Bean have been kindly supplied by the United States Department of Agriculture and will be planted during the coming season:—

17263	Austin.
17268	Ito San.
17271	Harberlandt.
17852 B	Peking.
21999	Taha.

Section VIII.—FIBRES.

The Improvement of Sea Island Cotton by Hybridization.

THE improvement of plants, both economic and ornamental is a problem which is commanding the attention of expert agriculturists and horticulturalists more and more every year; and within the last few years a large number of trained scientific men have seriously taken up the study of plant improvement, stimulated by the discoveries of Mendel of the underlying principles of hybrids, which were published in the Transactions of the Brunn Natural History Society in 1866. This paper was lost sight of until 1899, since when a very large amount of work has been done by investigators in many countries.

In these days when careful observations are being taken of plants grown on a large scale, and when new varieties are being tested in various countries, it is found that although many plants have certain excellent characters yet they may exhibit other characters which are not so desirable.

One variety may be producing a crop of excellent quality, but the quantity produced may be so small as to make it unremunerative to grow. There are many factors which may account for this, such as susceptibility to disease, small size of plant, or inability of plant to accommodate itself to climatic conditions, etc. There may be other plants which are exceedingly hardy, standing up well against diseases and producing large crops but of an inferior quality. It is seen that both these types of plants have certain very desirable qualities; and Mendel showed, and since his day many other investigators have shown that with many plants the good qualities of each can be combined together with the exclusion of the undesirable qualities.

The quality of a crop may be influenced by the conditions under which it is grown. Various places may start work with the same set of seed, but after a short time these various places may be each producing a crop of different quality. This is well illustrated with cotton in the various West Indian Islands; and in the United States of America the finest quality of Sea Island cotton is produced near the coast, there the quality remains more or less constant from year to year, but when grown inland it soon deteriorates and after a few years seed has to be brought again from near the coast.

In the early days of the recent revival in cotton growing in the West Indies, trials were made with different kinds of cotton, and as the result of these trials Sea Island Cotton was selected as the most satisfactory.

The quality of the cotton produced has not been in any way unsatisfactory. In 1908 when the West Indian Cotton Growing Conference was held in Manchester, Mr. E. Lomas Oliver stated to the West Indian cotton planters "You can grow cotton of the best description, better than anyone else in the world." This was after cotton growing had been in progress for some years. And in a letter recently received from Mr. Wolstenholme, the broker, through whose hands passes all the West Indian Sea Island cotton sent to the British Cotton Growing Association, he says "the ginning, preparing, etc. of West Indian Cotton never has left much to be desired and it is still as good as ever it was." There is therefore no doubt about the West Indies being able to produce the finest Sea Island Cotton, but the question of quantity produced has to be very seriously considered.

In Tobago as elsewhere in the West Indies the returns have not been satisfactory. At the 1908 Conference held in Manchester, Dr. C. E. Gooding of Barbados stated "when we first began to plant cotton in the West Indies we got very large yields, and if the yields per acre had kept up, well, we might have been able to grow cotton at a profit at one shilling per pound. But unfortunately, as the area over which cotton was planted extended, the pests that affect cotton also began to increase very much, and now I don't think we get half the yield per acre that we had three or four years ago."

In a report just published by the local Department of Agriculture of Barbados, Mr. Bovell, the Superintendent, says:—"The local Department of Agriculture continued certain experiments started in 1905 for improving the quality and increasing the quantity of lint obtained from the Sea Island Cotton. The seed of this variety was obtained from the Sea Islands in 1903, and at first the yield and quality was all that could be desired. Unfortunately, however, after it had been planted a few years the plants seemed to become susceptible to the attacks of fungoid diseases and insect pests, insomuch that the out-turn decreased considerably." It is therefore evident that attention must be directed towards making a hardier and a more productive plant.

Plant selection experiments have been carried on in Barbados since 1905, until January, 1908, by the Imperial Department of Agriculture in conjunction with the local Department of Agriculture and the planters, since then by the local Department in conjunction with the planters. The principle of this work was to select the most desirable plants in the field, and the seed from these selected plants was used to establish a nursery; the best plant in the nursery was then used to establish a nursery the following year, and the balance of the seed from the remaining plants for planting out in the general field. And now after five years very careful work Mr. Bovell points out that the "decreased yield combined with the drop in prices in the markets of the world caused a number of growers* to curtail the areas they planted annually, and in some instances to discontinue growing cotton entirely." To show the extent of the decrease he points out that in 1907–8, 7,194 acres were planted in cotton in Barbados, 1908–9, 5,768 acres, and in 1909–10, 4,121 acres.

Naturally one concludes that the plant selection experiments so carefully carried on in Barbados have not produced the results that were expected as regards increasing crop returns, for in spite of this plant selection the output has continued to decrease.

The quality of the cotton produced has not diminished as is shown by Mr. Wolstenholme's letter, but the crop returns have diminished. The plant is still a delicate plant and unable to stand up against the diseases.

It is therefore time that a new line of investigation was entered upon.

* In Barbados.

In these islands there are types of cotton thoroughly acclimatised, hardy and very prolific, and these can very readily be crossed with the Sea Island plants.

While I was connected with the Imperial Department of Agriculture in Barbados, I found in the season 1906–7 a different type of plant growing amongst the Sea Island plants in many of the Barbadian fields, and these struck me as being possibly hybrids, crosses between Sea Island cotton and a native type formed naturally. I tried and was successful in obtaining crosses between a good Sea Island type and a good native variety. As the bolls were not ripe when I left for Tobago in January, 1908, Mr. Bovell very kindly had the plants seen after for me, and when the bolls ripened sent the seed cotton on to me here. These were sown in July, 1908, and produced very large plants whose general appearance was that of overgrown Sea Island plants. The fruiting branches bore as many as twenty bolls and the cotton produced was very similar to the Sea Island cotton. They also gave very large yields, some of them producing as much as six pounds seed cotton. This experiment is still being continued along Mendelian lines with the object of producing a stable variety, and as most of the best qualities are dominant this takes a longer time than would have been the case had they been recessive.

In the crosses made in Barbados the Sea Island cotton plant was used as the mother plant.

In 1908, I made other crosses using the native type as mother plant, with the same result as given when Sea Island was used as mother plant.

A large sample of cotton obtained from plants grown from these last crosses was forwarded to the British Cotton Growing Association for report, no information as to origin whatsoever being given. And on March 7, 1910, the Secretary wrote:—

"WE duly received the sample of Sea Island cotton which we have submitted "both to our brokers and to Mr. E. Lomas Oliver. The latter writes as follows: "Many thanks for the sample of Dr. Gooding's cotton grown in Tobago which I "consider is slightly superior to that which he grows in Barbados." Messrs. Wolsten-"holme and Holland write: "The cotton is clean, good colour, staple fine and strong, 'value 19½d. per lb."

Yours faithfully,

E. H. OLDFIELD,
Secretary

Mr. Oliver evidently was under the impression that it was grown from seed obtained from Dr. Gooding's estate in Barbados. How he got that impression I do not know. However, this comparison with Dr. Gooding's cotton is of great interest, for at the Manchester conference held in 1908, Mr. Wolstenholme when asked what kind of cotton he would recommend to be grown, said: "There is a sample of cotton on the counter grown by Dr. Gooding. I consider it is the most suitable you can grow . . . . . It is strong cotton and not too fine." And now Mr. Oliver classes this as slightly superior to Dr. Gooding's. This is very encouraging as regards the quality of the cotton produced by these first crosses.

In the "Agricultural News" of July 23rd, 1910, the results of a similar experiment are described which had been worked by Dr. C. E. Gooding in Barbados. The trees produced by first crossed seed were very large, and he obtained from them heavy crops of cotton which was well reported upon.

Mr. Bovell also describes similar experiments in the report of the Local Department published August 19th, 1910, and he states "that there was a marked difference in the vigour and healthiness of the majority of the plants when compared with practically all the old varieties, while the lint in most instances was good."

At the present time I have about one and a half acres planted out in these first crosses. The seed was sown in August, September and October of this year. Those planted in August are at present exceptionally good, perfectly uniform, not a speck of disease to be seen anywhere, crowded with bolls and over seven feet high. It is the finest set of plants I have seen in the West Indies. At first one is under the impression that the plants are too high to be picked, but when the bolls ripen they weight the top of the plant down so that there is no difficulty in reaching any of the bolls.

The seed produced by these plants will not reproduce offspring like the mother plants, but a very great variety giving every possible combination of the Sea Island and native types, so that it would be necessary to prepare fresh crosses to supply seed for planting each season.

Up to the present the first hybrids have been perfectly uniform in my experiments, and there would be no difficulty in producing first hybrid seed to supply the requirements of the West Indies. A stable variety would be more desirable, but until we produce one the best plant so far seen in the West Indies is a first cross between Sea Island cotton and certain of the native types.

The Trinidad Department of Agriculture has made arrangements with me to supply all growers in Tobago and Trinidad with this hybrid seed during the coming season, and it is hoped by planting hybrids this Colony will produce cotton which will be highly remunerative.

Being larger plants than Sea Island they will require wider spacing, and I would not recommend rows to be closer than eight feet, and plants five feet apart in the row. This will allow about 1,089 plants per acre. If we calculate the returns at a low estimate, say 2 lb. seed cotton per plant, this would give 2,178 lbs. seed cotton per acre, as yet an unheard of return for seed cotton giving lint of the quality as reported on by the British Cotton Growing Association. Supposing the seed cotton to give 25 per cent. lint we should have 544½ lbs. lint per acre, against 175 lb. per acre given by Sir Daniel Morris at the Manchester Cotton Growing Conference in 1908 as being the average return of the Island of Montserrat and higher than the average of any of the other Islands for that season.

THOS. THORNTON,
Associate of the Royal College of Science, London. Late Travelling Inspector in connection with cotton investigations in the West Indies, connected with the Imperial Department of Agriculture.

TOBAGO,
8th December, 1910.

Notice to Cotton Growers.—(Tobago.)

SEA Island Cotton will be purchased at the Cotton Factory, Scarborough, on the first Wednesday of each month, between the hours of 9 a.m., and 12 noon. The factory will be opened on January 11th, 1911.

Clean Cotton only will be purchased, all stained Cotton and broken leaves must be carefully removed before bringing to the Factory.

"Wild Cotton" and "Marie Galante" must on no account be mixed with Sea Island Cotton.

The price paid for Sea Island Cotton will be according to the quality offered. For best Sea Island 7 cents per lb. of seed cotton will be paid.

Arrangements will also be made for cotton to be ginned and baled for Growers when so desired, and shipped to the British Cotton Growing Association to be sold on their account.

When cotton is to be shipped on behalf of Growers who comply with the conditions made by the Government, an advance of 20 cents per lb. of cotton lint of the best Sea Island quality will be made when shipped, to be repaid to the Government from proceeds of sale; and the nett price obtained less advance and expenses will be paid to the Grower in due course when account sales are received.

One and a half cents per lb. of lint will be charged for ginning and baling; or in lieu of this fixed charge, the actual expenses of ginning and baling may be arranged for.

P. CARMODY,
Director.

3rd January, 1911.

Notice to Cotton Growers.

NOTICE is hereby given that the Department of Agriculture has arranged for a supply of very special Sea Island Cotton seed for the coming planting season.

To obtain the best results the ground must be thoroughly prepared early in May, so that the seed may be planted with the first rains.

Intending Planters should give in their names at the Botanic Station, Tobago, stating the acreage they intend to plant.

The seed will be ready early in May, and will be supplied free of charge.

Those interested may see a plot of this new cotton on application to Mr. Thomas Thornton at "Old Grange" Tobago.

P. CARMODY,
Director.

20th January, 1911.

Paper from Megass.

(*Read at the International Conference of Tropical Agriculture, Brussels.*)

THE problem of utilising waste fibre from Sugar Cane has from time to time attracted the attention of sugar planters in all countries. The first patent for making paper from sugar cane was taken out by Berry in 1838.

During the 70 years since then there has been very little progress in this direction until the late Mr. Bert de Lamarre of the Tacarigua Factory, Trinidad, B.W.I., announced that his experiments had resulted in the production of a marketable article of fairly good quality.

Previous to this announcement it was believed that no better use could be made of megass than as a fuel for the boilers. Special furnaces had been successfully devised with the object of burning the wet megass as it came from the mill, which was a great improvement on the older method of slowly drying in the sun to fit it for use, still rather imperfectly, as fuel in the ordinary furnaces. Its value as a fuel was reckoned at 7s. 6d. a ton when coal costs 30s. a ton; but in Trinidad this value will be considerably reduced when local petroleum becomes available for industrial purposes.

There were many causes why megass could not be remuneratively converted into paper in former times, among which may be mentioned the

high prices of machinery and chemicals in tropical countries, the difficulties of obtaining skilled labour, and the comparatively low prices then prevailing for fibres even of the best kinds. Another cause of failure was the ambition to produce on the spot a white paper suitable for writing purposes.

The increasing high prices of fibres in recent years naturally drew attention to megass once more. Though used as a fuel it could still be regarded as a waste product, the quantity available was fairly large, and, in the cane growing countries, science had made such considerable strides in other branches of the sugar industry that machinery and chemicals were no longer unfamiliar materials, and Engineers and Chemists were employed in all the larger factories.

The first process employed by Mr. Bert de Lamarre consisted in fermenting the megass in heaps for the purpose of softening the harder fibres. This had the disadvantage of being a slow process. For two years he continued his experiments and he was subsequently advised and assisted by Messrs. Cross and Bevan the well-known fibre specialists.

The most suitable form for marketing the fibre necessarily received a full share of consideration.

The crude crushed fibre was too bulky for shipment in proportion to its value, pulp retained too large a percentage of water to make this product remunerative; and it was finally decided to prepare a crude paper or half stuff which could be shipped in sheets, and, being dried in the usual way, contained only a small proportion of water. Successful experiments were made in bleaching, but it was decided that ordinary brown sheets were the most likely to command a ready and remunerative sale.

A modern well equipped paper-making machine was imported, and experiments with it on a large scale confirmed the results which had been previously obtained by hand labour. This machine has been used for experimental work for more than a year, and in a short time the paper or half stuff—whichever is likely to prove more remunerative—will be placed on the market.

One of the most important results of these experiments is the improved quality of paper produced by the blending of megass with other local fibres which remedy the defects of the sugar cane fibre. Many sources of such fibres have been tried, e.g., Banana (leaf and stem) Agave, Maize, Hibiscus, Bamboo, Bois Canon (Cecropia peltata), Sunflower, native grasses and others. Of these a blend of Megass, Bamboo, and para grass has so far given the most successful results. These blends are more easily bleached than megass alone, and very fair specimens of white paper have been produced.

A rough estimate of the quantity of fibre available at the sugar factories of Trinidad will show the extent to which the cane sugar industry may be benefitted by the utilisation of megass, and the possible addition to the world's supply of paper making material. Roughly it may be calculated that for every ton of sugar produced a ton of crude fibrous material will be available, which gives for Trinidad 50,000 tons of fibrous material as the annual output. Allowing for 12 or 13 per cent. of water, and for a small amount of short pulverised fibre, there will remain about 80 per cent. of commercial fibre which corresponds to an output of 40,000 tons. As pulp this should be worth at a low valuation about £200,000. Purified to a better class paper-making material the 40,000 tons would probably be reduced to 30,000 tons worth about £12 a ton or £360,000; or when blended with bamboo and para grass worth £15 a ton or £450,000. Much of this crude paper could be sold locally for common wrapping paper on which the freight charges on imported paper of this quality are high in proportion to the value.

The output of sugar in the British West Indies, including British Guiana, is about 200,000 tons annually, which represents 200,000 tons of rough fibre; and the cane growing countries of the world with an output of 6,000,000 tons of sugar can produce about 4,000,000 tons of fibre worth in the form of paper at least £60,000,000 or about half the value of the world's output of cane sugar. As a subsidiary industry even if only £30,000,000 were realised it is well worthy of consideration by those engaged in the Cane Sugar industry.

P. CARMODY.

May, 1910.

Section IX.—SOILS.

Analysis of Tobago Soils.

It was reported to the Department that in the soil from Les Coteaux School Gardens, Cedar and Hibiscus grew three or four times faster than anywhere else in the district.

It is a sandy soil with a relatively high proportion of potash and phosphoric acid in readily available forms.

The soil from "Louis d'Or" Estate is from an experimental plot which had received an application of lime at the rate of one ton per acre.

REPORT.

The sample contains:—

	Louis d'Or Estate *	*Les Coteaux School Garden* †
Pebbles and sand	8	
Fine soil	92	
	100	
The air-dried fine soil contains:—		
Water	3·22	3·80
Organic matter and combined water	7·96	
Mineral matter	88·82	
	100·00	
COMPOSITION OF FINE SOIL DRIED AT 100° CENTIGRADE.		
* Organic matter and combined water	8·225	4·48
Soluble Silica	·713	
Oxides of iron and alumina ...	19·432	9·85
Lime	2·924	1·81
Magnesia	·238	1·06
Potassium oxide	·130	0·25
Sodium oxide	·131	·036
Phosphoric anhydride	·149	0·16
Sulphuric anhydride	Nil.	Trace.
Chlorine	·005	
Insoluble silica and silicates ...	68·052	82·43
	100·000	
* Containing:—		
Total Nitrogen	·215 %	·08 %
AVAILABLE PLANT FOOD.		
Potassium Oxide	·0060 %	·0460 %
Phosphoric anhydride... ...	·0493 %	·0760 %
Nitrogen as Nitrates	·0013 %	·0004 %

* Analyst—Joseph de Verteuil. † Analyst—C. Harold Wright.

Section XIII.—LIVE STOCK AND POULTRY.

Results of Analysis.

SAMPLE OF GRASS ("RABBIT MEAT") TELANTHERA POLYGONOIDES.

THE sample contains:—

Water	15·50
Dry substance	84·50
	100·00

COMPOSITION OF DRY SUBSTANCE.

Soluble albuminoids	Nil.
Insoluble albuminoids	11·06
Digestible fibre	30·33
Woody fibre...	20·78
Soluble ash	11·09
Insoluble ash	4·74
Amides, chlorophyll, etc.	22·00
	100·00

JOSEPH DE VERTEUIL.

Pedigrees of recently imported Stock (Government Farm).

DOMINION SHORT-HORN BREEDERS ASSOCIATION.

Certified Copy of Pedigree recorded in the Dominion Short-horn Herd Book.

Red Chief—78569.

Red, calved August 6th, 1909, bred by A. N. Griffen, New Minas, N.S., calved the property of Nova Scotia Agricultural College, Truro, N.S.

Dam.	*Sire.*
	Deeside Chief—60837 (91458)
Favourite's Gem—55905	Chief Ruler—45165 (80694)
Favourite's Fancy	Scottish Pride (imp.)—20839
Jeanette	Guardsman (imp.)—18956
Miss Lily	Premier Earl—1281 (48454)
Favourite 2nd	Highland Lad—1889
Favourite	Duke of Bedford—505
Dairymaid	Victor—1134
Daisy	Young Tweedside (imp.)—282
Snowdrop	Prince Albert—943
May Queen	Comet—432
Daisy	Young Forester (imp.)—276
Young Lily	Young Farmer (imp.)—275
Lily (imp.)—302	Warden—(1563)
Beauty	Rockingham—(560)
	Sir Harry—(1444)
	Colonel—(152)
	Colling's Son of Hubback—(319)

Chieftain—75033.

Red, mark in forehead, calved May 17th, 1908, by Wylie W. Reid, Oxford, N.S.

Dam.	*Sire.*
	Oxford Boy—56921
Daisy Walsingham—64840	Victor—25916
Daisy	Baron Booth—31572
Lady Walsingham 8th	Jock—31589
Lady Walsingham 4th	Dufferin—31570
Lady Walsingham 2nd	Yeo's Bull—4021
Lady Walsingham	Lord Clarence—28869 (22135)
Spot (imp.)—34303	Orthodox 28th—(18493)
Spangle	Guy Fawkes—(12980)
Nancy	Young Pompey—(13480)
Cherry	Burnham's Bull
Nancy	Son of David—(1917)
Old Nancy	Verta

CANADIAN JERSEY CATTLE CLUB.

Certified Copy of Pedigrees recorded in the Canadian Jersey Cattle Club Record.

Maud 3rd—1612 (Female).

Solid colour: black tongue and switch: calved July, 1908, bred by J. E. Baker & Sons, Barronsfield, N.S.

Dam.	*Sire.*
Maud—126 ...	... Hillside's Golden Lad—66564, A.J.C.C.

Ottawa, Canada,
January 24th, 1911.

Pedigree of Six Mares (Government Farm).

Name.	*Date of Birth.*	
Jerard	10/6/99	—By Serpa Pinto out of Peggy imported mare.
Lady Smith	6/5/00	,, ,, ,, ,, White Sock ,, ,,
My Honey	9/7/05	,, ,, ,, ,, Troy by Matchmaker.
Jora	6/5/05	,, Skye out of Jerard by Serpa Pinto.
Nulla	22/3/07	,, ,, ,, Troy ,, MatchMaker.
Imported Hackney.		
Victoria	24/5/00	,, Barthorpe Performer out of Nancy.

CANADIAN HACKNEY HORSE SOCIETY.

Register Certificate.

THIS is to certify that upon the application of Mr. T. R. Black the animal hereinafter described has been duly registered in the Canadian Hackney Horse Society stud book, vol. I.

Name, VICTORIA—150 Sex female.

Colour, Bay, Star, off hind foot white.

Date of Birth, May 24th, 1900, height.

Breeder, Hon. M. H. Cochraue, Hillhurst, Que.

Imported in by

Owner, T. R. Black, Amhurst, N.S.

Sire, Barthorpe Performer of (imp)—52—237 (5097).

Dam, Nancy (imp)—117—(4460).

Sire of dam, Matchless of Londesboro (imp)—14—(1517).

2nd dam,	Tidy—	By	Lord Beaconsfield, 1505.
3rd	,,	Nelly	,,	Shakespeare, 1554.
4th	,,	Patch	,,	Harkaway, 997.
5th	,,		,,	

H. WADE,
Secretary.

Parliament Buildings, Toronto,
Date, Sept. 7, 1901.

Section XIV.—AGRICULTURAL EDUCATION.

Winners of the Carmody Prizes.

AT the Central Show held on the 3rd February, 1911, in Port-of-Spain, and at Tobago these Prizes were won by the following:—

Mr. Ramcharan,	Carenage Government School (Best).
,, Julien,	Arouca R.C. School.
,, Prout,	Poole R.C. School.
,, Bonas,	Marabella R.C. School.
,, Hilaire,	Toco R.C. School.

The above Prizes are given for best all-round exhibits.

Section XV.—Miscellaneous.

Influence of Malaria on Labour Supply.

Paper read by Professor Carmody, Director of Agriculture, &c., at the Brussels International Congress.

In most tropical countries there is a scarcity of agricultural labour, and this scarcity is frequently further accentuated by the loss or inefficiency that results from attacks of malarial fever.

The influence of malaria on the labour supply is now fully realised. In some countries the use of quinine has been adopted as a preventative as well as a cure, and with excellent results. This has led to the free distribution of quinine in some places, but no statistical results are yet available. In British Guiana there has been free distribution for over a year and the results though not yet published, are reported to be very favourable.

I do not propose in this paper to refer to the beneficial results obtained in other places from the use of quinine. I will merely show, from the figures given in the excellent tables contained in the annual reports of the Protector of Immigrants. the serious diminution in the labour supply caused by malarial fever. In Trinidad the supply of agricultural labourers is very inadequate, and has to be supplemented annually by the importation of about 2,500 immigrants from India. These immigrants are indentured for five years to Sugar and Cacao estates, and are, during the whole period of their indenture subject to the regular supervision of the Medical Department of the Colony and of the staff of the Protector of Immigrants. They are carefully looked after, and the figures given in the table may be taken as the minimum of loss of agricultural labour that may be expected when working under favourable conditions.

The figures for the sugar and cacao estates are shown separately. The latter are situated usually on hilly lands, the former on the flat lands; and the difference in the percentage of malarial cases is, as might be expected, very much in favour of the cacao estates.

Taking the sugar estates on which the number of immigrants approaches 10,000—a number large enough to give trustworthy statistical results—we find in the best year, (1905) more than half the total supply was entered in the case books as attacked by malaria, and with one exceptional year, (1909) the number of cases treated has exceeded the total number of Immigrants.

The money value of the loss can be easily calculated. Taking 1909 the last year for which figures are available, there have been 7,744 cases on sugar estates, each working unit being worth at least 30 cents per day. This represents an annual loss in the earnings of the labourers of $2,323.20 if the malaria attack lasts only one day, and $9,292.80 if the attack lasts four days. Four days may be taken as a low average rate of duration of malarial fever of the ordinary type. To this must be added the indefinite loss of efficiency during the period of convalescence which may extend to 10 or 12 days.

In a Colony dependent upon Immigration for its labour supply another aspect presents itself. The loss of 7,744 working units per year represents for 300 working days a loss of about 26 immigrants per year, if disabled for only one day, or about 100 immigrants if the disability extends to four days. This loss is a serious one in a Colony such as Trinidad.

It will be seen that the death-rate among immigrants is low showing that they are a fairly healthy race.

The total number of immigrants, indentured and unindentured, exceeds 100,000; and the total agricultural population exceeds 200,000. Government medical supervision is practically confined to indentured immigrants, and it may be safely assumed that the remainder of the agricultural population suffers from malarial attacks to a similar extent at least. This represents a very serious aggregate loss of labour per annum which could be prevented to a large extent by the cheap distribution of Quinine.

Return of Malarial Cases entered in the Case Books by Government Medical Officers.

Trinidad 1900-1909.

Year Ending.	Sugar Estates.			Cacao Estates.			Death rate ₩ 1,000 of Indentured Immigrants (over 10 yrs.)	General Death rate Trinidad & Tobago.
	Indentured Immigrants.	Total Cases.	Percentage.	Indentured Immigrants.	Total Cases.	Percentage.		
Dec. 1900 ...	5,860	8,663	147	397	222	56	19·5	23·7*
March 1902 ...	6,954	8,760	126	536	277	51	19·9	25·0
„ 1903 ...	6,624	7,557	114	770	309	40	19·6	23·4
„ 1904 ...	7,076	8,219	116	1,004	462	46	17·8	24·2
„ 1905 ...	7,758	5,086	65	1,076	413	38	17·0	21·3
„ 1906 ...	8,659	9,382	108	1,245	491	39	15·5	25·9
„ 1907 ...	7,873	8,364	106	1,365	691	50	15·8	24·0
„ 1908 ...	9,266	9,450	102	1,663	798	48	14·5	25·6
„ 1909 ...	8,142	7,744	95	1,736	972	56	17·1	23·0

* Trinidad only.

P. CARMODY.

May, 1910.

Chicle or Chewing Gum.

The Department has been informed that there is an increasing demand for this article, and for the information of local planters the following particulars have been kindly supplied by a manufacturer's representative who recently visited the Colony :—

Chicle.—The non-fruit bearing Zapote—tree contains the quality of Sap required for Chewing Gum manufacturing.

The process by which "Chicle" is gathered is as follows :—The chicleros go into the woods and form a camp in the vicinity of the place where they are gathering the gum. They carry small cans which they attach to the trees, making a sort of V shaped cut into the bark, from

which the sap oozes into the can. These cans are brought to a central point or camp or at least their contents are gathered and brought to the camp and here it is strained through sieves or cloths into a cauldron or kettle, under which a fire is kept burning while the entire mass is stirred constantly to prevent burning. The sap goes into the kettle very much of the consistency of milk, sticky milk, and when it is properly cooked, thus evaporating as much of the moisture as possible, the mass now very much thicker in consistency is poured into moulds in the form of large bricks weighing possibly 20 lbs. a piece, and when these are hardened (dried in the air) ten or a dozen of each such bricks are packed in sacking, cleaned closemeshed bagging in which it is transferred to New York, and generally two sacks are used to ensure the safe, clean arrival of the goods, the outer cloth being of heavy course material.

The choicest "Chicle" that we receive does not contain more than 30 to 32 per cent. of moisture, and some of it runs down as low as 26 per cent.

In event you get any of this product, please send samples of the stuff to the S. S. C. Co., 5 lbs. would be plenty for a proper examination, and give advice, how much you can get of the quality of which you submit samples, how much you have on hand, how much can be produced and how much can you guarantee to deliver year by year.

If the merchandise is properly strained and boiled and delivered in such packages as guarantee its purity and cleanliness, it is worth, roughly speaking, 30 cents a pound c.i.f. New York, without duty, but a quotation without a sight of the sample of merchandise would be unfair, since some otherwise very fine quality Chicle is so full of dirt, that is to say particles of bark or leaves or charcoal, that the factory would not touch it at any price, where again the goods may be improperly boiled, resulting in their being very damp, in which case we either don't care for them, or would not give a very high price for them.

Jerusalem Pea.—A Cover Crop.

On sending a supply of this the Director of Agriculture, Jamaica, writes as follows:—This plant is botanically *Phaseolus trinervis* and is closely allied to and probably only a variety of *P. mungo*.

The East Indians know the plant under the name of "Urd."

"Our subsequent experience since I wrote the note in my annual re- "port indicates that the 'Jerusalem Pea' will not grow in dense shade, and "I am quite doubtful whether it would grow in your cocoa cultivations in "Trinidad. Where cocoa is growing under bananas and only partially "shaded this plant provides a good cover and is useful in keeping down "weeds.

The seed has been distributed among several planters who take an interest in Cover crops, and has grown well in the open and under light shade. At "River" Estate it has failed to grow under cacao not too heavily shaded.

With reference to it Mr. A. V. Stollmeyer writes:—"It may be of "interest to you to know that many of my cocoa contractors in Santa Cruz "plant the above kind of peas. The yield per acre is greatly in excess of "any other specie obtainable in Trinidad, and from information elicited my "contractors say that is their reason for planting this quality in preference "to any other."

"On visiting young contract fields yesterday for the purpose, I was "astonished at the abundance of growth produced by a single plant, and "this on hilly land of not too fertile a character."

A specimen of the plant growing at Santa Cruz was sent to Jamaica for identification. The Director of Agriculture reports that it is identical with the Jerusalem Pea grown there.

Agricultural Products Exported, 1910.

	Values.	*Quantities.*
Cacao	£1,230,097 ...	57,858,640 lbs.
Sugar	623,949 ...	46,247 tons.
Molasses	10,433 ...	743,679 gals.
Rum	9,588 ...	191,641 ,,
Bitters	33,521 ...	33,521 ,,
Coconuts	66,651 ...	18,872,962 nuts.
Copra	18,707 ...	2,046,621 lbs.
Coconut Meal	nil. ...	nil.
,, Oil	1,465 ...	3,989 gals.
Fruit	19,952	
Cotton	626 ...	11,315 lbs.
Lime Juice	1,287 ...	4,324 gals.
Timber	18,744 ...	160,384 cub. ft.
,, ...	431 ...	10,344 sup. ft.
Rubber	1,395 ...	7,376 lbs.
Live Plants	550	
Live Stock	4,076 ...	193
Hides and Skins ...	4,584 ...	4,568

(Agricultural Society Paper No. 422.)

Indentured Labour and Preventable Diseases.

By George H. Masson, M.D., D.Sc., M.R.C.P., E., Fellow of the Royal Institute of Public Health, London.

Read before the Society, 21st June, 1910.

* * * * * * * *

In fact, up to a certain point, everything seems to have been done, and done well, to perpetuate the oldest industry in these parts; but, gentlemen, when the labour supply is secured do the planters exercise with respect to that most important and costly item of expenditure the same careful economy observed in other departments of their business? Before replying, let us consider the return of diseases among indentured labourers, furnished by the Surgeon-General to the Protector of Immigrants for 1907–8, which may be accepted as an average year. There were in all approximately 10,000 indentured immigrants distributed over the various estates. From this population the entries in the books of the estate hospitals show that there were 28,592 cases of disease under treatment or, roughly speaking, each

immigrant was, on the average, laid up in hospital, on three separate occasions during the year. From an authoritative memorandum kindly placed in my hands, I find that the average period for which each patient remained in the hospitals of one of the largest and best equipped sugar estates was nine days, and I propose to adopt that number as a basis of calculation in respect to the other estates. Thus, by multiplying the total number of cases, namely, 28,592, by 9, we get 257,328, which was the number of day's work lost to the planters by reason of sickness among the labourers. Now, the average cost of maintaining one labourer in hospital for one day is estimated at fifteen cents, hence the cost of maintaining 28,592 cases for nine days is, leaving out the cents, $38,603, or well over £8,000. A healthy immigrant, employed on five days in every week, should work for 260 days in the year. Therefore 260 days' work may be taken as his normal labour output, from which it follows that 257,328 days work represent the annual toil of 989 labourers. In other words, from a population of nearly 10,000 indentured immigrants, we find that nearly 1,000 are constantly on the sick list and unable to work, and not only do the planters lose the profits derivable from their labour,—profits, which, calculated at five cents on each day's work, are equivalent to the huge sum of $12,866 or over £2,680, but they also sustain a dead loss of more than £8,000 per annum over their maintenance in hospital.

The result of this extensive disablement is that necessary work on the estate must remain undone, or if free labour is obtainable, and is substituted for the shortage of healthy immigrants, then it is plain that the planters are paying for about a thousand more indentured labourers than they are getting any benefit from, or, to look at it in another way, they have to get nearly one thousand more than they actually require, which, if I may presume to say so, does not, in either case, appear to accord with the ordinary principles of economy. If I have ventured to make this criticism it is only because I am fully persuaded that the enormous sickness rate among the indentured immigrants is not an essential part of the wear and tear of sugar cultivation, but it is an unnecessary and, to a very large extent, preventable burden. For what do the hospital returns show?

That among the principal diseases treated are:—

Dysentery	930	Cases.
Malaria	10,248	,,
Anæmia	1,499	,,
*Ankylostomiasis	124	,,
Digestive System	2,120	,,
Ground Itch	456	,,
Parasites	1,258	,,
Skin Diseases	4,527	,,
Local Injuries	259	,,
Respiratory System	285	,,
Rheumatism	758	,,

Excluding the three last causes of illness mentioned on this list, all the rest referred to diseases in respect of which the causes and means of eradication are well understood by medical science.

* From a report kindly supplied to me by the Colonial Secretary, since the presentation of this paper, it appears that the total number of cases treated in the estate hospitals during 1908–9 was 25,055, of which 994 were placed under the heading of ankylostomiasis, with the following comments by Dr. J. W. Eakin, the then Acting Surgeon-General:—"994 cases of ankylostomiasis were recorded as against 121 cases during 1907–8, while the following group of diseases—anæmia, ground itch, parasitic skin diseases (in which are probably included cases of ankylostomiasis) yielded 6,213 cases as compared with 7,740 cases during the previous year,—contrasts which are of interest as indicating more careful diagnosis."

Dysentery, which must not be confronted with diarrhœa, is a specific disease caused by a particular form of organism which swarms in the discharges of persons suffering from the disease. These organisms frequently find their way more usually during the rainy season, into drinking water exposed to surface contamination. Not unusually the disease is conveyed from individual to individual through the agency of flies, but the universal experience is that it vanishes from any locality in which it has previously been endemic on the introduction of a pure supply of potable water.

Malaria, as every one knows, is transmitted from sick to sound by means of the bites of the anopheles mosquito; the best means of preventing infection is to get rid of the mosquitoes by searching for and destroying their larvæ whenever found, by abolishing their breeding ground by drainage and cultivation of the soil, by the careful and assiduous removal from the neighbourhood of factories and barracks and other dwelling places of all useless receptacles capable of holding stagnant water, and by the screening or petrolisation of such vats and other vessels as are considered necessary for the storage of water. By rendering dwelling-houses mosquito-proof the chances of infection are greatly diminished. In Italy, India, West Africa, in some parts of Canada and, recently, in Demerara, the regular administration of quinine to workers in malarial districts has done much to diminish the rate of infection, even where other prophylactic measures are not employed. 10,248 cases of malaria in one year among a population of less than 10,000 souls is, considering that the means of prevention are known and practicable, beyond dispute, a state of things which calls for improvement. Parasites, exclusive of the hook worm, to which I shall presently refer, and skin diseases together account for 5,785 days lost in hospital. The bulk of these cases are due to dirt, personal uncleanliness, eating with soiled fingers, sly drinking of contaminated water, and to filthy habits generally. Much can be done in the way of providing proper washing and bathing facilities for the labourers, and by compelling them to change loin cloths and other garments so engrained with dirt as to be offensive or injurious to health. No labourer should be allowed to defeat, with impunity, the object of his contract and become a burden to the planter through sheer neglect to observe even a low standard of ordinary cleanliness.

Anæmia, digestive troubles, ground itch and ankylostomiasis together furnish 4,176 cases. These diseases are grouped together because, on the estate, they are practically all due to infection with the hook worm or *ankylostoma duodenale.* The mouth of this small creature is provided with a fringe of hooks by means of which it attaches itself to the inner lining of that portion of the small intestine which is in immediate continuity with the stomach. It lives on the blood which it sucks from the bowels. The females are usually more numerous than the males, and after impregnation they lay a prodigious quantity of eggs which, happily, do not hatch in the intestines of the infected person, but pass out of his body in the stools. Once deposited in damp soil, the eggs, which may readily be recognized under a low power of the microscope, hatch out little larvæ which grow for a while, and then develop a protective capsule in which they lie dormant, until swallowed by man, in food or water, or through the medium of soiled hands. The disease set up by the worms is apt to run a chronic course, owing to constant re-infection. The gastric irritation caused by the worms, and sometimes by other intestinal parasites as well, is not infrequently associated with a depraved state of the appetite in which the patient craves for dirt. This condition is known as geophagia or allotriophagy, and as the dirt eaten is often contaminated with the eggs of the hook-worm, re-infection is indefinitely kept up. When trodden upon by bare feet the larvæ

sometimes burrow into the skin and produce the form of irritation known as ground itch. The profound anæmia of estate coolies is, in most cases, due to hook-worm disease, and so also are the bulk of the digestive or "belly" troubles which go to swell the number of Hospital admissions. I must confess to some difficulty in understanding why planters patiently suffer 4,000 and odd coolies, otherwise valuable labourers, that is to say, more than two-fifths of the whole indentured population to be put out of action yearly by this most preventable of diseases. In 1896, 85 per cent. of the miners round about Brunnberg, a large mining centre in Austria, were found to be infected with ankylostomiasis. As a result of medical treat ment and the adoption of preventive measures, the percentage of sufferers was reduced to 47 per cent. in 1898, 26 per cent. in 1889, 23 per cent. in 1900, 12 per cent. in 1901, and 8 per cent. in 1902.

In England a similar outbreak recently occurred in a Cornish mine, and was the subject of investigation and report by an inspector of the Local Government Board. The cause of the disease was the same as in Trinidad. Ignorance and filthy habits on the part of the miners, and the failure of the mine-owners to provide proper sanitary conveniences for the men underground. How was the condition met? First of all, recourse was had to the power of legislation, and the Home Secretary caused the following rules to be enforced:—

1. The owner, agent, or manager shall cause a sufficient number of suitable sanitary conveniences to be provided above and below ground in convenient places for the use of persons employed, and to be constantly kept in a cleanly and sanitary condition, and no person shall relieve his bowels below ground elsewhere than in these conveniences.

No person shall soil or render unfit for use in any way any convenience or sanitary utensil or appliance provided for the use of the persons employed. Pump cisterns and water accumulations in the mine shall not be used for the purpose of a sanitary convenience.

2. It shall be the duty of the owner, agent or manager to see that plant, material and other things necessary to enable the above rule to be carried out are provided and maintained in working order, and to appoint sufficient competent officials to enforce the requirements of the rules and for this purpose to assign to each his respective duties.

In spite of the rules great difficulty was experienced in getting the men to change their old habits. They would not go any distance to make use of the latrines, but preferred to squat in any handy recess near by. Those who did use the latrines, stood on the seats and fouled them, so that others declined to go in. To prevent this nuisance a special pattern of closet was devised with a sloping roof pitched so low as to leave no standing room for the men who were therefore compelled to sit on the seats. Care was taken to instruct the miners as to the unhealthiness and danger of impregnating the soil with fœcal matter. They were warned against the habit of eating with soiled hands, and were taught to handle their food through papers so as to keep their fingers out of actual contact with their mouths. After work was over, they were encouraged to change their clothes and wash before sitting to their meals, and every man was impressed with the necessity, as a matter of duty, to report any comrade found breaking the rules.

Now, if all this care and education are necessary in the case of the miner born and bred in the light of the civilisation of England itself, it follows that the raw East Indian labourer cannot reasonably be expected to give up insanitary practices to which he has been accustomed all his life, without some teaching too, or without being provided with similar facilities for adopting cleanly habits to those found necessary for labourers in more

civilised centres. Our neighbours of the Magnificent Province have already recognised these facts, and a good deal is now being done by them in the way of quinine prophylaxis against malaria, the provision of latrines on sugar estates, the improvement of water supplies, the systematic examination of immigrants, particularly of new arrivals, for evidence of ankylostomiasis, and the routine administration of vermifuges to actual or suspected cases of ankylostomiasis or other forms of nternal parasitic diseases.

"The immigrants themselves," says Dr. Godfrey in his last annual report, "take an intelligent interest in their cases, and have come to realise the importance of getting rid of the 'Belly Worms'." In the section of his report he also states that "the number of plantations without latrine accommodation for their labourers becomes less year by year, and in a short time every estate will have some latrine accommodation which will gradually be brought up to the requirement."

What valid reason have we for lagging behind the planters of Demerara in these matters?

I admit that the whole problem of estate sanitation in this Colony is beset with difficulties among which the question of water supply is one of the greatest importance, but, gentlemen difficulties are made to be overcome, and if these are tackled in earnest they will not be found insuperable.

It may be that the uses of preventive medicine have not yet gripped the popular imagination, but, for the sugar planter who has already availed himself so largely of modern scientific methods, the time has come to recognise and apply the means which science has placed at his disposal for preventing the waste of material so expensive as human labour and thereby substantially reduce the costs of his finished products. You are all aware of the disasters which befell the first company to attempt the stupendous undertaking which is now within measure of completion next door to us at Panama. The same engineering skill which gave the Suez Canal to the world's commerce could also have accomplished the work which is now being done by the United States Government, but the attempt failed, and failed from the lack, at that time, of the knowledge of preventive medicine which we have at our command to-day, and of the thousands who went to dig the canal the great majority either dug the graves of their comrades, or had their own dug instead. That the Canal Zone is now one of the healthiest localities in the world is a marvellous circumstance which leaves no doubt in our minds as to the potentialities of preventive medicine. What is required in our industries is the awakening of a Public Health conscience in master and man; and even if there are doubts regarding the co-operation of the labourers, without which no efforts on the part of the administration can be entirely successful, it would be fallacious to argue that, because everything desirable cannot be obtained it is therefore useless to attempt anything, and I consider that by adopting a broad and well reasoned policy of sanitary reform on the estates of the colony, not only will the obligation, which must rest on the employer to safeguard and preserve the health of the indentured population committed to his care, be fulfilled, but such action will at once improve the efficiency of the labourer himself, and will also, in course of time, result in a yearly saving of thousands of pounds now spent uneconomically, if I may venture to say so, in the futile treatment of preventable disease without attempting to remove its causes.—(*Proceedings, Agricultural Society.*)

Section XVI.—RAINFALL.

RAINFALL RETURNS 1910.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total 1910.	Average in district 1910.	Total Jan.-Dec., 1909.
North West District.															
St. Clair—Royal Botanic Gardens ...	2·79	4·38	1·75	2·01	2·76	6·34	6·40	13·89	8·27	9·21	8·49	1·90	68·19	...	64·58
Port-of-Spain—Colonial Hospital ...	2·40	1·75	1·39	1·94	2·08	5·24	5·07	13·39	5·59	6·46	7·66	1·43	54·40	...	51·69
,, Royal Gaol ...	2·34	3·79	1·63	2·32	2·13	5·69	7·25	14·15	6·65	8·07	7·94	·65	62·61	...	54·85
,, Constabulary Head-quarters ...	1·05	4·74	1·82	2·92	2·07	6·04	6·54	13·70	6·03	8·04	7·24	1·39	61·58	...	57·36
St. Ann's—Reservoir	3·16	3·62	2·18	2·87	3·51	8·88	6·61	13·99	13·04	12·76	12·16	1·71	84·49	...	81·36
,, Coblentz Avenue ...	2·65	2·94	1·46	1·43	2·90	6·56	6·75	13·29	9·47	9·90	7·98	2·44	67·77	...	66·19
Maraval—Reservoir	4·68	6·79	2·85	3·06	5·56	8·31	7·71	15·43	10·63	9·93	11·56	2·50	88·94	...	86·29
,, Constabulary Station ...	4·05	7·04	3·16	3·29	7·69	8·75	8·99	11·54	12·67	6·86	9·01	3·02	86·07	...	92·55
Diego Martin ,, ,, ...	5·83	6·18	2.59	3·00	6·44	8·33	7·91	10·50	7·22	7·24	4·77	3·02	73·03	...	66·11
,, ,, Water Works ...	5·88	6·46	2·42	2·90	4·96	8·80	8·19	10·90	7·28	6·33	7·96	2·98	75·06	...	70·21
,, ,, River Estate ...	5·98	6·74	2·53	2·90	5·38	8·96	8·29	10·72	6·90	6·18	7·39	2·89	74·86	...	79·07
Fort George Signal Station ...	3·07	3·74	3·03	1·89	4·59	7·19	6·40	12·50	9·00	9·28	8·88	2·45	72·02	...	69·07
North Post ,, ...	5·00	7·50	2·05	2·09	4·47	8·12	6·51	11·36	7·15	6·73	5·45	1·78	86·21	...	63·18
Carenage Constabulary Station ...	1·51	3·85	1·36	1·75	5·46	11·32	8·20	11·52	10·65	9·37	11·51	2·19	78·69	...	67·79
Carrera Island Convict Depôt ...	1·47	4·16	1·07	2·31	3·96	6·22	4·92	11·48	7·46	5·83	5·43	1·57	55·88	...	56·64
Chacachacare Light House ...	6·41	6·04	4·10	3·13	4·30	6·03	3·54	7·03	5·15	6·30	5·95	2·86	61·14	72·11	67·55
Santa Cruz—Maracas District.															
Santa Cruz Constabulary Station ...	6·25	9·21	3·21	3·86	6·37	8·13	4·52	14·44	8·02	11·64	9·36	2·05	87·06	...	92·53
St. Joseph ,, ,, ...	1·78	4·20	·63	1·40	4·33	7·82	6·76	9·90	6·12	8·06	6·37	2·50	59·87	...	63·13
Maracas—Ortinola Estate ...	5·15	9·74	2·99	3·44	5·33	7·23	6·91	11·36	7·24	13·68	7·41	2·65	83·13	...	78·10
,, Government School ...	6·71	10·30	2·76	3·33	6·16	7·93	6·59	9·15	7·35	14·31	8·95	2·21	85·75	78·95	83·79
West Central District.															
Caroni, Frederick Estate	4·63	11·19	5·73	8·50	7·61	15·38	13·40	20·74	7·58	15·75	13·56	5·69	129·76	...	125·64
Chaguanas, Constabulary Station ...	2·15	9·48	1·63	2·54	5·15	8·40	6·47	12·94	9·65	7·42	7·96	2·22	67·01	...	82·78
,, Woodford Lodge Factory ...	1·91	7·98	1·38	2·20	5·37	7·09	6·95	13·09	9·41	7·57	8·15	2·46	73·48	...	88·67
Carapichaima, Waterloo Estate ...	1·99	9·06	1·09	3·07	4·68	8·55	9·04	13·26	10·77	8·81	6·75	2·91	79·98	...	83·48

RAINFALL RETURNS, 1910.—CONTINUED.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total 1910.	Average in each district 1910.	Total Jan.-Dec., 1909.
West Central District.—Contd.															
Couva, Exchange Estate ...	1·48	9·71	1·30	1·60	3·48	4·82	5·51	9·46	7·64	6·98	5·79	2·26	60·03	...	69·66
,, Brechin Castle ,, ...	1·74	9·87	1·87	2·49	4·13	6·14	7·52	12·13	8·03	7·35	5·75	3·58	70·60	...	79·07
,, Perseverance ,, ...	1·29	9·31	1·54	2·45	3·68	4·92	6·68	14·88	8·84	6·93	5·79	2·83	69·14	...	67·66
,, Camden ,, ...	1·17	7·76	1·21	2·36	2·96	3·84	4·69	8·07	5·31	8·36	4·65	2·44	52·82	...	64·68
,, Milton ,, ...	1·57	9·76	1·57	2·77	4·06	6·50	7·61	10·95	5·46	7·96	6·43	2·83	67·47	...	73·76
,, Esperanza ,, ...	1·52	8·47	1·66	2·20	3·53	6·02	7·37	11·09	5·70	9·68	6·69	3·17	67·10	73·73	70·76
San Fernando and Princes Town District.															
Claxton's Bay, Forres Park Estate ...	2·29	7·47	1·16	2·13	3·67	5·27	6·90	8·52	4·80	4·65	6·99	2·29	56·14	...	68·07
Pointe-à-Pierre, Bonne Aventure Est...	2·08	7·05	2·27	3·22	4·57	10·59	6·12	8·41	7·62	10·10	7·97	3·93	73·93	...	71·87
Naparima, Picton Estate	1·43	5·71	3·20	2·05	4·24	9·00	7·06	8·79	7·79	6·16	6·43	2·23	64·09	...	72·57
,, Usine Ste. Madeleine Est....	1·58	11·28	2·69	3·79	2·75	9·14	12·04	10·86	4·98	8·33	10·36	2·92	80·72	...	69·52
,, La Fortunée Estate ...	·84	7·42	2·27	4·35	3·65	10·88	7·50	8·57	7·99	7·05	6·07	1·78	68·37	...	69·32
,, Craignish ,, ...	·00	9·90	·41	3·40	4·25	8·05	10·30	13·46	3·10	8·43	8·96	3·74	74·00	...	80·85
,, Lewisville ,, ...	1·22	9·47	2·20	4·24	5·76	10·43	10·51	13·49	4·76	9·08	9·01	4·68	84·85	...	72·80
Princes Town, Cedar Hill Estate ...	1·61	10·35	3·95	3·25	3·39	11·42	10·07	12·99	5·57	8·68	5·89	1·66	78·83	...	73·77
,, ,, Constabulary Station ...	1·90	10·05	3·56	3·12	5·62	10·11	8·93	12·80	6·03	8·35	8·45	4·20	83·12	...	76·39
Savana Grande, New Grant Estate ...	2·73	9·96	3·33	3·68	5·47	12·42	10·02	13·05	4·03	11·74	9·78	4·67	90·88	...	81·80
,, ,, Malgretoute ,, ...	1·66	7·78	3·08	3·22	5·11	8·83	6·44	13·81	5·33	7·29	7·61	4·59	74·78	...	62·79
,, ,, Friendship and Ben Lomond Estate...	1·00	7·95	4·10	2·00	3·20	7·80	9·05	12·90	6·30	5·55	5·90	1·00	66·75	...	59·65
Poole, El Rosario Estate	4·76	13·87	2·40	6·23	8·34	15·37	12·10	14·12	4·12	7·58	15·61	5·29	109·79	77·40	103·62
Montserrat District.															
Montserrat, Constabulary Station ...	2·60	12·85	1·82	3·27	3·27	8·10	10·92	12·87	5·12	9·06	8·05	3·17	81·10	...	94·06
Brasso, La Vega Estate	2·43	14·85	2·97	3·52	4·17	10·41	7·99	15·16	6·18	10·97	9·85	4·85	93·35	87·22	100·07

RAINFALL RETURNS* 1910.—CONTINUED

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total 1910.	Average in each district 1910.	Total Jan.-Dec., 1909.
Arima District.															
Arima, Torrecilla Estate	3·87	7·51	2·85	3·35	5·81	14·64	8·81	11·88	8·21	13·66	9·39	4·86	94·84	...	111·13
San Rafael, Constabulary Station ...	4·22	11·19	2·42	5·64	5·11	18·26	15·83	15·33	4·73	16·16	13·60	5·18	117·67	...	98·28
Guanapo, Talparo Estate	5·64	14·32	3·89	5·84	7·81	14·64	10·53	16·83	6·37	10·79	11·00	3·61	111·27	107·92	109·29
South-West District.															
Oropuche, Pluck Estate	2·45	5·22	1·90	2·40	3·52	11·86	8·10	11·87	7·60	9·73	8·04	3·28	75·97	...	68·71
,, Constabulary Station ...	1·65	7·50	5·56	3·72	3·56	10·21	8·10	10·02	8·96	9·02	6·91	2·57	75·98	...	68·59
Siparia, ,, ,, ...	3·33	9·01	4·78	4·84	5·76	12·83	10·40	15·66	12·89	11·95	9·05	4·90	105·40	...	107·08
Cedros, ,, ,, ...	3·38	8·21	5·42	4·63	5·16	9·97	6·13	11·52	2·69	12·82	7·32	3·31	80·56	...	54·27
Cap-de-Ville, ,, ,, ...	1·50	5·07	8·23	8·51	4·35	19·61	8·06	13·23	8·02	6·76	8·23	4·58	96·15	...	85·84
Guapo, Adventure Estate ...	3·31	3·64	4·84	5·67	2·25	10·94	6·12	9·66	6·48	6·04	8·19	2·11	69·25	...	65·66
Erin, La Resource ,, ...	2·26	4·75	5·51	2·83	3·96	10·92	6·39	15·00	5·30	8·94	9·12	6·85	81·83	83·58	59·92
North Coast.															
Blanchisseuse, Constabulary Station ...	8·63	21·74	6·15	6·76	10·17	16·99	9·12	11·52	6·74	9·80	10·09	3·40	121·11	121·11	95·93
East Coast.															
Matura, La Juanita Estate... ...	8·33	12·08	5·81	5·93	10·42	11·84	9·75	11·07	9·38	20·14	13·46	4·42	122·63	...	120·76
Sangre Grande, Sta. Estella Estate ...	7·04	14·35	6·06	8·62	10·95	15·92	10·40	14·37	6·87	17·00	14·59	6·37	132·54	127·58	120·84
Tobago.															
Tobago, Botanic Station	1·71	4·27	3·09	2·51	4·01	9·16	8·80	6·00	10·42	9·22	8·83	4·41	72·43	...	85·83
,, Hermitage Estate ...	5·45	7·98	9·58	4·20	8·44	10·56	8·52	8·73	10·09	15·03	14·60	5·15	108·33	...	115·78
,, Riversdale ,, ...	5·53	4·98	5·07	2·70	5·09	7·84	4·66	8·27	10·54	14·53	9·79	4·55	83·55	...	76·72
,, King's Bay ,, ...	5·13	8·13	6·53	3·86	4·88	9·39	4·90	7·40	10·26	9·73	11·35	3·81	85·47	...	97·44
,, Government Farm ...	·69	2·82	1·75	1·96	1·82	5·72	5·86	3·68	6·86	5·75	7·92	2·08	46·91	79·33	61·60

* The rainfall for any district during previous years will be supplied on application to the Head Office. See also Bulletin No. 66.

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Section XV.—Miscellaneous.

Minutes of the Board of Agriculture.

At a meeting of the Board of Agriculture held in the Council Chamber on Friday, 22nd April, 1910.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (PRESIDENT) *in the Chair.*
THE DIRECTOR OF AGRICULTURE (VICE-PRESIDENT).
THE HON'BLE MR. C. DE VERTEUIL.
,, ,, ,, G. T. FENWICK, C.M.G.
,, ,, ,, R. S. A. WARNER, K.C.
MR. J. P. BAIN.
Lieut.-Colonel J. H. COLLENS, V. D.
MR. J. D'ABADIE.
,, H. E. MURRAY.
,, J. MOODIE.
,, L. SEHEULT, B. SC.
,, E. L. SELLIER.
,, THOS. THORNTON.
,, J. H. WADE.
THE GOVERNMENT BOTANIST (HON. SEC.)
,, MYCOLOGIST, MR. J. B. RORER, M.A.
,, ENTOMOLOGIST, MR. F. W. URICH, F.E.S.
,, ASSISTANT ENTOMOLOGIST, MR. P. L. GUPPY.
,, CURATOR OF BOTANIC GARDENS, MR. F. EVANS.

Apologies for non-attendance were received from Messrs. Kay and Greig through the Director of Agriculture.

The minutes of the previous meeting were confirmed after the following alterations to the Minutes of 25th February, requested by the Director of Agriculture had been made :—

1. Office to be at St. Clair, Director of Agriculture dissented.
2. Resolution of 27th November, 1908, cancelled at the request of the Director of Agriculture.
3. The Assistant Director to take over the whole duties of Secretary. Director of Agriculture dissented.
4. Mr. A. E. Collens appointment to terminate on 28th February, 1910.
5. The Clerical Assistant to the Director of Agriculture to continue for one month or be given one month's salary in lieu of notice.

The financial Statement was submitted.

FINANCIAL STATEMENT.

Balance January 31st ...	...	$11,113 96	
To Agricultural Tax for January	...	1,973 36	
,, ,, ,, February	...	1,505 74	
,, ,, ,, March	...	1,951 40	
Other Receipts	...	6 42	$16,550 88
By Payments during February	...	990 05	
,, ,, ,, March ...	...	1,074 29	
,, ,, up to 21st April ...	...	991 04	3,055 38
Balance	...	...	$13,495 50

The Secretary read a letter from the Hon. Mr. Sydney Fisher, Canadian Minister for Agriculture and from Mr. Theodore Ross, Secretary for Agriculture, Prince Edward Island, in relation to exportation of cattle bred on Government Farms, the latter stating that the conditions under which Government stock was sold was that the stock were not to be removed from the Province of Prince Edward Island.

The report of the Advisory Committee in regard to the Central Agricultural Show, was submitted recommending that the Board do not contribute to the prize fund of the Central Agricultural Show, on the motion of Mr. H. E. Murray seconded by the Hon. Mr. C. de Verteuil the report was adopted.

The report of the Advisory Committee with Mr. Louis Seheult, B. Sc., on the Agricultural Education report was laid on the table.

A minute paper in relation to the publication of handbooks relating to the Colony was submitted, and on the suggestion of His Excellency the Governor the matter was referred to a Committee consisting of:

Lt.-Col. Collens, V.D., Chairman.

Messrs. Bain, Wade and Carruthers.

The Secretary asked the Board to sanction the appointment of an Assistant at a salary of £10 per mensem, and on the motion of Mr. J. Moodie seconded by the Hon. Mr. G. T. Fenwick, the Board approved. The Government be asked to allow the services of Mr. Eric Legge of the Registrar-General's Department to be lent to the Board for the above appointment.

The services of Mr. P. L. Guppy were retained until the end of the year on the motion of Hon. Mr. G. T. Fenwick seconded by Mr. H. E. Murray.

Papers relating to Agricultural Banks referred by Government were submitted and after some discussion, on the suggestion of His Excellency the Governor, the Secretary was instructed to return the papers with a view to their being dealt with by the Agricultural Society.

Mr. Thornton called attention to the fact that the Board had not replied to two letters sent by the Tobago Planters' Association, in one case asking for information as to the prospects of rubber in the Colony, and the

other requesting that Mr. Carruthers might be sent to Mexico to investigate rubber tapping methods there. The Board instructed the Secretary to answer the first letter and referred the second matter to the Advisory Committee.

The following resolutions were passed by the Board on the motion of the Hon. Mr. C. de Verteuil seconded by Mr. H. E. Murray:—

1. "That the Government be requested to allow the Board to carry out a series of experiments at *River Estate* to elucidate the question of shade, best distance apart of trees, and other important questions of cacao cultivation."

2. "That for the purposes of carrying out these experiments the sum of £600 be set aside by the Board. £200 for Manurial Experiments at *River Estate* or elsewhere, and £400 for Botanical.

3. "That a Committee consisting of the Director of Agriculture, the Assistant Director of Agriculture, Mr. J. P. Bain and Mr. d'Abadie be appointed to draw up a scheme of experiments to be submitted to the Board."

A communication to His Excellency the Governor from the Secretary of State forwarding a letter from Mr. T. Thornton of Tobago to the Chairman of the British Cotton Growing Association, and asking for the Board's report as to Mr. Thornton's work on the amelioration of cotton and its possibilities was submitted to the Board.

The matter was referred to a Committee consisting of the Government Botanist and Messrs. Thornton and R. B. Dickson for report.

The Secretary presented an estimate of expenses for the current year, and it was decided to refer these to the Advisory Committee for report. Suggestions were made for an additional sum for manurial experiments by the Director of Agriculture and for purchase of agricultural machines by Mr. Thornton, and these were passed on for consideration by the Advisory Committee.

The Secretary reported that Mr. R. B. Dickson, an agricultural expert who had been investigating cotton, maize, &c., in America and Africa, was at present attached to the Department of Agriculture, and that his services were being utilized on the rubber and other experiments. The Board expressed its appreciation of the value of these services and authorized the Secretary to pay Mr. Dickson's travelling and out of pocket expenses.

The reports of the Government Mycologist and Entomologist were ordered to be printed and circulated.

Mr. Rorer the Government Mycologist asked that he might be authorized to furnish a report on his work for a year to be printed and published. Approved.

The Director of Agriculture stated that he was going on leave from the Colony for two months on 2nd May. The Assistan tDirector would be in charge of the Department.

The meeting adjourned till Friday, 20th May.

J. B. Carruthers,
Hon. Secretary.

Minutes of the Board of Agriculture.

At a meeting of the Board of Agriculture held in the Governor's Office, Red House, on Friday, 1st July, 1910, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE GOVERNOR, (PRESIDENT) *in the Chair.*
THE HON'BLE MR. G. T. FENWICK, C.M.G.
" " " R. S. A. WARNER, K.C.
" " " C. DE VERTEUIL.
Lieut.-Colonel J. H. COLLENS, V.D.
MR. J. MOODIE.
" H. E. MURRAY.
" J. P. BAIN.
" WILLIAM GREIG.
" THOMAS THORNTON.
THE MYCOLOGIST, MR. J. B. RORER, M.A.
" ASSISTANT ENTOMOLOGIST, MR. P. L. GUPPY.
" ENTOMOLOGIST AND ACTING HON. SEC., MR. F. W. URICH.

Appointment of Mr. F. W. Urich, Acting Honorary Secretary—(C.S.M.P. 4210/1910.)

His Excellency the President announced that in consequence of Mr. Carruthers' illness he had appointed Mr. F. W. Urich to act as Honorary Secretary.

The Board approved of this appointment.

Confirmation of Minutes.

The Minutes of the last meeting of 22nd April having been previously circulated were taken as read and confirmed.

The following letters were submitted:—

Leave of absence granted to Messrs. d'Abadie and McLeod.

From Mr. Jos. d'Abadie dated 6th June, 1910, asking for 5 months leave of absence and from Mr. J. J. McLeod, dated 18th June applying for 4 months leave. These applications were granted.

His Excellency the President announced that the Honourable Mr. Kay had telephoned his regret at not being able to attend the meeting.

Questions by Tobago Planters' Association *re* rubber.

With reference to Mr. Thornton's remarks at the last meeting *re* letters from the Tobago Planters' Association as to the prospects of rubber in that Colony, the Honourable Mr. Fenwick enquired what steps had been taken. In reply Mr. Thornton stated that on his recent visit to Tobago Mr. Carruthers had explained the situation to the members of the Tobago Planters' Association and that they were satisfied.

Cacao experiments at *River Estate.*

The Hon. Mr. de Verteuil drew attention to the fact that the Committee appointed for the purpose of drawing up a scheme for experiments at *River Estate* had not met. The Acting Secretary stated that it was not possible to have a meeting on account of the absence of the Director and Mr. d'Abadie and the illness of the Assistant Director.

MISCELLANEOUS.—*Continued.*

The Financial statement was submitted:— Financial Statements.

FINANCIAL STATEMENT.

Receipts.

Balance on 21st April	$13,495 50	
Agricultural Tax for April	1,717 66	
,, ,, ,, May	2.020 52	$17,233 68

Payments.

Payments 22nd to 30th April	$ 784 00	
,, during May	2,651 25	
,, ,, June	1,105 76	$ 4,541.01
Balance in hand		$12,692 67

Special Votes.

Laboratory ($1,500) to 30th June	$ 1,470 50
Sugar Cane Experiments (Froghoppers ($3,022) expended to 30th June	550 00
Rubber Tapping Experiments ($3,000) expended to 30th June...	163 12
Coconut Palm destruction ($500) expended to 30th June ...	461 93

The following recommendations of the Advisory Committee were submitted to the Board:—Meeting of the Committee on June 13th, 1910. Recommendations by Advisory Committee.

(1.) Meeting of the Board fixed for 17th June to be postponed to 1st July or until Mr. Carruthers can attend.

Approved.

(2.) Messrs. Rorer and Urich to proceed with the issue of the *Bulletin* for July.

Approved.

Meeting of Committee on 1st July.

(3.) Estimates of Expenditure for the year 1st April, 1910, to 31st March, 1911, based on estimated Receipts of $16,000.

HEADS OF EXPENDITURE.

Salaries	$ 9,024 00
Amount to be deposited at Receiver-General's Office towards salary of Assistant Director	2,184 00
Laboratory	800 00
Library	500 00
Office Contingencies	300 00
Disease Prevention	1,000 00
Illustrations for Bulletins and Reports	300 00
Travelling Expenses of Members and Board's Officers ...	1,200 00
	$ 15,308 00

Approved.

4. Application by Mycologist for a further amount of $500 for Coconut Palm destruction.

Approved.

5. Seedling Cane Experiments.

Referred to Sugar Committee of the Board for early action.

On the motion of the Hon'ble Mr. Fenwick seconded by Mr. Murray it was decided that the meetings of the Advisory Committee should take place some days before the regular meetings of the Board and the Minutes circulated so as to enable members to consider the recommendations. Meetings of Advisory Committee.

Purchase of Agricultural Machines for Tobago.

Mr. Thornton mentioned that his suggestion as to the purchase of agricultural machines for Tobago referred for consideration by the Advisory Committee at the last meeting had not been dealt with. His Excellency the President confirmed the above and referred the matter again to the Advisory Committee.

Plant Protection Ordinance—New Committee appointed.

In connection with the vote $500 for Coconut Palm destruction the Hon. Carl de Verteuil thought that it was time that the proposed Plant Protection Ordinance should be put into force and asked why it had been delayed.

The Acting Secretary said that the Committee appointed on the 21st May, 1909, for the purpose of drafting the Ordinance had not met and that 2 of the 3 members were absent from the Colony.

His Excellency the President thereupon appointed the following new Committee to deal with the Ordinance:—

The Hon. Mr. Warner, Messrs. Greig, Rorer and Urich (Secretary.)

Annual Report of the Mycologist.

The Mycologist (Mr. Rorer) presented his annual report which the Board directed should be printed in the *Bulletin*. His Excellency the President said that the report was satisfactory and that he desired to put on record his appreciation of the work done by Mr. Rorer.

Annual Report of the Entomologist.

The Entomologist (Mr. Urich) laid his annual report before the Board and it was decided that it also should be published in the *Bulletin*. His Excellency the President said that the remarks he made with regard to the Mycologist's report should also apply to Mr. Urich's.

Authority for expenditure in 1909-10.

A letter from the Hon. Auditor-General dated 9th May, 1910, asking to be furnished with the Board's authority for expenditure incurred during the year ended 31st March, 1910, under the following heads was submitted:

(1.) Entomological Expenses	$ 454 05
(2.) Mycological	317 71
(3.) Purchase of Fungicides and Insecticides ...	313 64
(4.) Miscellaneous	60 14
(5.) Advances	365 00
	$1,510 54

On the motion of the Hon'ble Mr. de Verteuil seconded by Mr. Murray the above expenditure was authorized by the Board.

Mr. Murray's question *re* Plant Protection Ordinance.

As a new Committee on the Plant Protection Ordinance had just been appointed Mr. Murray withdrew his question and motions with regard to this Ordinance.

The following letters and papers were submitted :—

St. Augustine Estate—Estimates.

(1.) C.S.M.P. No. 4019/10 of the 11th June, 1910, *St. Augustine Estate* Estimates for 1910-11. "Referred by His Excellency the Governor for the consideration of the Board."

His Excellency the President directed that the Estimates be circulated and then considered at the next meeting of the Board.

Resignation of Mr. C. W. Haynes.

(2.) C.S.M.P. 3966/10 of the 14th June, 1910. Resignation of Mr. C. W. Haynes as an acting member of the Board.

It was decided that Mr. Haynes be thanked for his services and that his resignation be accepted.

Appointment of Mr. J. W. Arbuckle.

To fill the vacancy on the Board caused by the death of Mr. Bert de Lamarre, His Excellency the President decided that the appointment be offered to Mr. J. W. Arbuckle.

(3.) Letter dated 10th May, 1910, from Manager Permanent Nitrate Company, asking whether the Board would undertake some experiments with Nitrate of Soda on Cacao and Sugar Estates, and offering the sum of £100 towards the expenses. Letter from Manager Permanent Nitrate Company.

The Acting Hon. Secretary was directed to accept the offer provisionally and obtain further information as to the contribution of £100 for carrying out the experiments.

(4.) Letter dated 18th February, 1910, from the President Lowney Chocolate Company, Boston, U.S.A., suggesting the establishing of Government Standards for Commercial Grades of Cacao. Letter *re* Standards for Cacao.

Referred to Cacao Committee. The Secretary was further directed to supply the Trinidad Cacao Planters' Association with a copy of the letter.

(5.) Analysis of Soils, &c., in connection with Manurial Experiments at *River Estate.* Manurial Experiments at *River Estate.*

To be published in the *Bulletin.*

On the Suggestion of Lieut.-Colonel Collens Mr. Moodie was added to the Committee in connection with the *Handbook of Trinidad.* Handbook on Trinidad.

The Colonel applied for 4 months leave of absence as from the 8th August and asked for the Board's authority to make arrangements, while in England, for the preparation of a small map of Trinidad and illustrations. The sum of £20 was voted by the Board for this purpose.

After thanking the Members for their attendance His Excellency the President adjourned the meeting to Friday the 29th instant.

F. W. Urich,
Acting Hon. Secretary.

Minutes of the Board of Agriculture.

At a Special Meeting of the Board, held in the Council Chamber, on Friday, the 22nd July, 1910, at 2.15 p.m.

Present:

His Excellency the Governor, (President) *in the Chair.*
The Director of Agriculture.
,, Hon. Mr. C. de Verteuil.
,, ,, ,, R. S. A. Warner, K.C.
Lieut.-Colonel J. H. Collens, V.D.
Mr. J. P. Bain.
,, L. de Verteuil.
,, J. Moodie.
,, J. H. Wade.
,, Thomas Thornton.
,, J. W. Arbuckle.
The Mycologist, Mr. J. B. Rorer, M.A.
,, Assistant Entomologist, Mr. P. L. Guppy.
,, Entomologist and Acting Hon. Secretary, Mr. F. W. Urich.

Upon taking the Chair His Excellency the President addressing the Members said that he had summoned them to attend this meeting to express their very great grief and sorrow at the recent loss of an Officer of the Board in the person of Mr. J. B. Carruthers, late Assistant Director of Agriculture. His Excellency referred to the serious loss the Government and the Board of Agriculture had sustained by his death, especially in relation to the Cacao and Rubber industries in which Mr. Carruthers was an expert.

The reading of the Minutes of the last meeting, held on the 1st July was postponed to the next regular meeting.

Professor Carmody on behalf of himself as Head of the Department of Agriculture as well as the Members of the staff of the Department regretted deeply the death of Mr. Carruthers whom he said they had learnt to appreciate.

The Hon. Mr. de Verteuil on behalf of the Members of the Board concurred in the expressions of sympathy that had fallen from His Excellency and Professor Carmody.

His Excellency the President announced that he had received a letter from the Hon. Mr. W. Kay regretting his inability to attend the meeting and desiring to be associated with the resolutions to be passed.

Mr. Thornton on behalf of the Planters in Tobago expressed deep sorrow at the sad loss they had sustained.

On the motion of His Excellency the President seconded by the Director of Agriculture a formal vote was passed expressing the Board's deep regret at the death of Mr. Carruthers and conveying its deep sympathy to his widow and other relatives in their affliction.

The Acting Secretary was directed to forward a copy of this resolution to the late Officer's widow and relatives.

To fill the temporary vacancies on the Advisory Committee His Excellency the President appointed Mr. Moodie to act for the Hon. Mr. G. T. Fenwick and Mr. Arbuckle to act for the Hon. Mr. S. Henderson.

After announcing that a meeting of the Advisory Committee would take place on the 29th instant at his office for the purpose of making recommendations for the selection of a successor to the late Mr. Carruthers, His Excellency adjourned the meeting to Friday next.

F. W. URICH,
Acting Hon. Secretary.

Minutes of the Board of Agriculture.

At a meeting of the Board of Agriculture held in the Governor's Office, Red House, on Friday, the 29th July, 1910, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE GOVERNOR, (PRESIDENT) *in the Chair.*
THE DIRECTOR OF AGRICULTURE.
,, HON. MR. C. DE VERTEUIL.
,, ,, W. G. KAY.
,, ,, R. S. A. WARNER, K.C.
Lieut.-Colonel J. H. COLLENS, V.D.
MR. J. P. BAIN.
,, L. DE VERTEUIL.
,, W. GREIG.
,, H. E. MURRAY.
,, J. L. MOODIE.
,, L. SEHEULT, B.SC.
,, J. H. WADE.
,, J. W. ARBUCKLE.
THE MYCOLOGIST, MR. J. B. RORER, M.A.
,, ASSISTANT ENTOMOLOGIST, MR. P. L. GUPPY.
,, OFFICER IN CHARGE EXPERIMENT STATION, MR. W. E. BROADWAY.
,, ASSISTANT SECRETARY, MR. A. DEVENISH.
,, ENTOMOLOGIST AND ACTING HON. SECRETARY, MR. F. W. URICH.

Welcome to Dr. Gough. His Excellency the President, on behalf of the Board, welcomed Dr. L. H. Gough, the Entomologist sent out by Proprietors of Trinidad

Sugar Estates in London and promised him every assistance on the part of the Board and its officials.

The Minutes of the Meeting, held on the 1st July having been circulated were taken as read, those of a meeting held on the 22nd July were read, after which the minutes of both meetings were confirmed. Confirmation of Minutes.

The Hon. Mr. R. S. A. Warner referred to a very unfortunate statement which had appeared in the *Port-of-Spain Gazette* last Sunday with reference to the late Assistant Director of Agriculture, Mr. J. B. Carruthers, whose work was described as unsatisfactory. On behalf of himself and the Members of the Advisory Committee, as well as all those who had agricultural interests in the Colony, he said that such a statement could not be accepted by them, as they all knew what Mr. Carruthers had done in the short period he had been in the Colony and had respected him in his work. Protest against statements made in *Port-of-Spain Gazette* with reference to the late Mr. J. B. Carruthers.

Professor Carmody drew attention to an omission in the Minutes of a meeting held on the 22nd April, with regard to the Report of the Committee on Agricultural Education and Prizes for improved Cacao Cultivation. To rectify this omission, the following recommendations of the Advisory Committee of the 5th April, were adopted on the motion of Col. Collens, seconded by Mr. Murray, viz.:— Agricultural Education and Prizes for Cacao cultivation.

> "The Advisory Committee having considered their report on "Agricultural Education recommend that the consideration "of Sections 1 and 2 (Agricultural Education) be postponed for "twelve months, that the Section referring to Prizes for "improved Cacao Cultivation be adopted and the Section "relating to Prizes to Cane Farmers be deleted."

The Director of Agriculture was asked to take the necessary steps with regard to the Prizes offered for improved Cacao Cultivation.

The following letters were read:—

1. From Mrs. J. B. Carruthers, dated 25th July, 1910, thanking His Excellency the President and Members of the Board for their sympathy in connection with her recent bereavement. Letter from Mrs. J. B. Carruthers.

Laid on the table.

2. From Mr. J. P. Bain. dated 29th July, applying for 4 months leave of absence from 22nd August. Leave of absence to Mr. J. P. Bain.

This application was granted.

The Financial Statement was submitted:—

FINANCIAL STATEMENT. Financial Statement.

Receipts.		
Balance on 30th June	$12,692 67	
Agricultural Tax for June	1,801 12	$14,493 79
Payments.		
Payments during July	1,241 40	$ 1,241 40
Balance in hand		$13,252 39

Special Votes.

Laboratory ($1,500) expended to 31st July	$ 1,500 00
Sugar Canes Expts. (Froghoppers) ($3,022) expended to 31st July	550 00
Rubber Tapping Expts. ($3,000) expended to 31st July ...	303 18
Coconut Palm Destruction ($1,000) expended to 31st July ...	461 93
Exhibits at Local Shows ($200) expended to 31st July ...	128 72
Rubber Curing House ($1,000)	Nil.
River Estate Expts. ($2,880)	Nil.
Handbook ($96)	Nil.

Recommendations of Advisory Committee.

On the motion of the Hon. Mr. de Verteuil seconded by Mr. Murray the following recommendations of the Advisory Committee were adopted:—

1. Appointment of Assistant Director of Agriculture *vice* the late Mr. J. B. Carruthers.

    The Committee recommends the appointment of an Official with a general knowledge of tropical Agriculture at a salary of £500 to £600 per annum.

    That in future the Secretaryship of the Board to be separate from the post of Assistant Director of Agriculture.

    When a Rubber Expert is required the Board will engage one specially.

2. Signing of Cheques.

    Recommended that the Hon. Mr. de Verteuil be appointed *vice* the Hon. Mr. Fenwick on leave of absence.

3. C.S.M.P. 141/1910. Correspondence with British Cotton Growing Association *re* Cotton growing in Tobago.

    Recommended that the papers be referred to a Committee consisting of Professor Carmody, Messrs. Bain and Murray for early report.

4. Termination of services of Mr. Pinder.

    Recommended that Mr. Pinder be given a month's notice as his services are no longer required.

Increase to salary of Assistant Secretary.

It was decided that the salary of the Assistant Secretary Mr. A. Devenish be increased by $15 a month as from the 1st June when the appointment took effect.

Mycologist's Report.

The Mycologist said that he had nothing of importance to report, but the work was going on nicely. The destruction of diseased Coconut Palms was being carried out along the East Coast in the Mayaro district. When that district was completed Mr. Plummer would begin work along the North Coast, starting at Blanchisseuse. That would complete the round of the Island. When this was done he would advise that another round be made, which would not take very long and then similar work could be started in Tobago.

Entomologist's Report.

The Entomologist said that the Froghopper experiments were progressing favourably. He asked that he be allowed to submit a progress report which would be printed and circulated before the next meeting of the Board.

Visit of inspection by His Excellency the Governor.

His Excellency the President stated that he had paid a visit of inspection to the Research Laboratory at St. Clair and found that the work that was being done there was most satisfactory. His Excellency also mentioned that in company with the Director of Agriculture he had visited the Experimental Plots at *River Estate* and was pleased with the good work that was carried on there.

The following papers were submitted:—

Estimates *St. Augustine Estate.*

C.S.M.P. 4019/10. Estimates *St. Augustine Estate* for 1910-11.

Referred back to the Director of Agriculture for fuller information with regard to the Revenue and Expenditure on Current and Capital Accounts.

Standard for Cacao.

The suggestions of the Cacao Committee were laid on the table and it was decided that this matter be referred to a Committee consisting of a Government Member, a Member of the Board and a Member of the Chamber of Commerce. The Board appointed the Hon. Mr. de Verteuil as its representative and decided that the Chamber of Commerce be requested to nominate a representative. Cacao Standards.

C.S.M.P. 3920/07. Truck System. Truck system.

Referred back to the Committee. It was decided that Mr. Bert de Lamarre's place on the Committee should not be filled.

C.S.M.P. 6702/08.—Engagement of Entomologist by Proprietors of Trinidad Sugar Estates in London. Engagement of Entomologist by proprietors. Sugar Estates in London.

The correspondence in connection with Dr. Gough's appointment was laid on the table and postponed for further consideration.

C.S.M.P. 4514/10.—Appointment of Mr. J. W. Arbuckle as a member of the Board. Appointment of Mr. J. W. Arbuckle.

Laid on the table.

C.S.M.P. 4368/10.—Hon. Mr. G. T. Fenwick's application for leave of absence for 5 months from the 11th July. Leave of absence to Hon. G. T. Fenwick.

Approved by the Board.

C.S.M.P. 2737/10.—Report of the British Delegate to the International Sugar Commission, July, 1909. Report of British Delegate to International Sugar Commission July, 1909.

It was decided that the Report be published in the *Bulletin.*

C.S.M.P. 1396/10.—Publication of *Handbook* relating to Trinidad. Handbook on Trinidad.

The Report of the Committee giving the Heads of Chapters was approved and Col. Collens was authorized to expend an additional amount not exceeding £25 for the preparation of a map.

The results of the Rubber Tapping Experiments at Longdenville from the 8th April to the 8th July, were laid before the meeting, also a sample of the rubber prepared there and a sample from Ceylon for comparison. Several photographs showing the process of tapping and preparing the rubber were exhibited. Result of Rubber Tapping Experiments at Longdenville.

His Excellency announced that he would be away on leave for three months and thanked the members for their advice and assistance during the past year. The Hon. Mr. de Verteuil on behalf of the Board wished His Excellency a pleasant holiday. The meeting then adjourned to the next regular day. Absence from the Colony of His Excellency the Governor.

F. W. Urich,
Acting Honorary Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, 26th of August 9.15 a.m.

PRESENT;

HIS EXCELLENCY THE ACTING GOVERNOR (PRESIDENT) *in the Chair.*
THE DIRECTOR OF AGRICULTURE.
„ HON. MR. S. HENDERSON.
„ „ „ C. DE. VERTEUIL.
„ „ „ R. S. A. WARNER. K.C.
MR. L. SEHEULT, B.SC.
„ THOS. THORNTON.
„ J. W. ARBUCKLE.
THE MYCOLOGIST, MR. J. B. RORER, M.A.
„ ASSISTANT ETOMOLOGIST, MR. P. L. GUPPY.
„ MANAGER GOVT. STOCK FARM, MR. J. McINROY.
„ ASSISTANT SECRETARY, MR. A. DEVENISH.
„ ENTOMOLOGIST AND ACTING HON. SECRETARY, MR. F. W. URICH.
DR. L. H. GOUGH, was also present.

Minutes.

The Minutes of the last meeting held on the 29th July, having been circulated, were taken as read and confirmed.

Standards for cacao.

With reference to Standards for Cacao, His Excellency the Acting Governor informed the Board that he proposed to invite the Agricultural Society to nominate a representative to sit on the Committee that had been appointed.

Letter from Mr. Moodie.

The following letters were read:—

(1.) From Mr. J. L. Moodie, dated 24th August, 1910, regretting his inability to attend the meeting.

Leave of absence to Mr. H. E. Murray.

(2.) From Mr. H. E. Murray, dated 8th August, 1910, applying for 3 months leave of absence from the 22nd August.

This application was granted.

The following Financial Statements were submitted:—

Financial Statements.

(1.) FINANCIAL STATEMENTS.

Receipts.		
Balance on 31st July	$13,252 39	
Payments.		
Payments to 25th August	495 97	
Balance in hand	$12,756 42	
Special Votes.		
Sugar Cane Experiments (Froghopper) $3,022) expended to 31st July	...	$634 90
Rubber Tapping Experiments ($3,000) expended to 31st July	...	429 08
Coconut Palm Destruction ($1,000) expended to 31st July	...	563 28
Exhibits at Local Shows ($200) expended to 31st July	...	130 45
Rubber Curing House ($1,000) expended to 31st July	...	nil.
River Estate Experiments ($2,880) expended to 31st July	...	nil.
Handbook ($216) expended to 31st July ...	...	nil.

(2.)—STATEMENT OF REVENUE AND EXPENDITURE, FROM THE 21ST DECEMBER, 1908 to 31ST MARCH, 1910.

RECEIPTS.	$	c.	EXPENDITURE	$	c.
To Agricultural Tax on Cacao	$18,850	20	By Office Contingencies	$ 344	32
,, ,, ,, Sugar	3,462	88	,, Travelling	856	95
,, ,, ,, Coconuts	1,935	58	,, Salaries	7,914	83
,, ,, ,, Copra	444	70	,, Library	44	44
,, Sale of Rat Virus	6	42	,, Entomologist Fittings	362	71
,, Sundry Refunds made	6	65	,, Mycologist ,, ...	452	86
			,, Froghopper Experiments	379	21
			,, Manure and Insecticides	363	16
			,, Fungicides	70	48
			,, Analyses	120	00
			,, Disease Prevention	5	50
			,, Exhibition	68	53
			,, Laboratory	849	64
			,, Coconut Destruction	186	35
			,, Rubber Experiments	6	25
				$12,025	23
			,, Cash at Colonial Bank	12,535	27
			,, ,, on hand	155	93
	$24,716	43		$24,716	43

(Sgd.) A. DEVENISH,
Asst. Secretary for Acting Hon. Secretary.

23rd August, 1910.

Certified correct,

(Sgd.) CHAS. PANTIN,
Acting Auditor-General.

24th August, 1910.

It was decided that this Statement be circulated and brought up again at the next meeting.

On the motion of the Hon. Mr. de Verteuil, seconded by Professor Carmody, the following recommendations of the Advisory Committee, dated 19th August, were adopted :—

Recommendations by Advisory Committee.

(1.) Appointment of Secretary.

The Committee recommends the continuation of the appointment of Mr. F. W. Urich as acting Honorary Secretary.

(2.) Offices and Laboratories at St. Clair.

The Secretary was directed to prepare plans and estimates of the building required and submit them at the next meeting of the Board.

(3.) Purchase of Agricultural Tools.

Recommended that catalogues be obtained from Manufacturers for the use of the Board.

(4.) Letter from the Mycologist asking for a vote of $200 to cover the cost of making blocks and prints for plates to illustrate reports in course of preparation.

Recommended.

(5.) Rubber experiments.

(*a.*) Recommended that the experiments be continued and for the present the Department of Agriculture be requested to carry them out.

(*b.*) That the tapping experiments be extended to Sir Edward Tennant's estates.

(*c.*) The Committee further suggests the names of Messrs. J. H. Wade and Moodie for appointment as a Committee to deal with all rubber matters.

Mycologist's Report.

The Mycologist said that during the past month the cacao spraying experiments had been continued, and he devoted as much time as possible to coconut disease as it was very necessary that the two most important diseases of the coconut, bud-rot and root disease, should be determined definitely if the Plant Protection Ordinance was to be enforced. He had been able to reproduce bud-rot successfully, both by simply pouring a pure culture of the bud-rot organism into the crown of a coconut palm, and by wound inoculations. After a few months in each case the trees had died with all the characteristics of bud-rot. So far as he knew this was the first time that successful inoculations by pouring cultures into the crown of the palms had been obtained, and they show that insects can transmit the germs to healthy palms. The root disease of the coconut was perhaps the most serious disease in the Southern district but the cause of it had not been definitely worked out. Stockdale's report was rather inconclusive as far as the isolation of the causative fungus was concerned. The speaker had found several fungi, other than Diplodia, in the diseased roots, any one of which might be the cause. In connection with the Froghopper fungus it was known that several years ago a number of dead froghoppers were found covered with a fungus, and that fungus had been sent away for identification, but no one knew whether it was *post mortem* or not. He had obtained pure cultures of the fungus and in co-operation with Mr. Urich had made a few preliminary tests, which, although not as conclusive as he would like them to be, seem to show that the fungus was parasitic. The inoculation experiments would be continued on a larger scale.

The Entomologist reported that the Froghopper experiments at Chaguanas were going on as well as they might and gave some results of the clean weeding of the fields, but he said that the experiments were somewhat hampered by the want of labour. Referring to the biological work in connection with the Froghopper he mentioned that eggs were deposited singly on the ground near grass and cane roots the egg stage lasted a longer or shorter period according to the weather, and the young froghopper took from 35–41 days to complete its development, the adult females lived for about 3 weeks. In the fields males predominate over the females to the extent of 57–66%, more males are attracted to trap light. He did not think that the Froghopper could be controlled by catching the adults. As savannah grass was the natural food plant and grew abundantly in many cane fields, clean weeding was the best means he knew of, at present, to control this pest. Entomologist's Report.

The following papers were submitted to the Board :—

1. Mr. L. A. Brunton's application for sick leave (based on medical certificate) from 7th to 22nd August. Sick leave to Mr. L. A. Brunton.

   Approved.

2. C.S.M.P. 1396/10.—Publication of *Handbook* relating to Trinidad. *Handbook* on Trinidad.

   His Excellency the Acting Governor thanked the Board for its liberal contribution towards the expenses of the *Handbook* and said that as soon as the blocks for the illustrations and MS. were ready they should be forwarded to the Government who would arrange for the printing.

3. C.S.M.P. 4769/10.—Letter from International Rubber and Allied Trades Exhibition, London, asking that a representative be sent from Trinidad. Representative for Rubber Exhibition, London.

   It was decided that it was desirable that the colony should be represented and His Excellency the Acting Governor stated that the Permanent Exhibition Committee would be asked to arrange for an exhibit.

4. C.S.M.P. 4515/10.—Temporary vacancies on the Board. Temporary vacancies on the Board.

   The Board suggests that the vacancies caused by the absence of the Hon. Mr. Fenwick, Messrs. d'Abadie, Bain and André should be filled by acting appointments.

5. C.S.M.P. 4741/10.—Cotton growing in Crown Colonies. Cotton growing in the Crown Colonies.

   Laid on the table.

6. Prizes for improved Cacao Cultivation—Progress Report. Prizes for Cacao growing.

   The report was approved, and the details of the scheme were referred to the Cacao Committee to be dealt with.

7. Para Rubber Seeds—Proposals for a further supply. Para Rubber Seeds.

   It was decided that the Government be asked for a further importation of one million seeds.

Manurial experiment on Cacao.

8. Manurial Experiments on Cacao.

Professor Carmody stated that his only reason for bringing this up was to obtain a vote for these experiments. His Excellency the Acting Governor on referring to the Minutes of the 22nd April, said that £200 had been allocated.

Castilloa Rubber—visit to Mexico *re.*

9. Letter from Mr. J. P. Bain, dated the 18th August, 1910, suggesting a special visit to Mexico in connection with the Castilloa Rubber Industry.

On the motion of the Hon. Mr. Warner, seconded by the Hon. Mr. de Verteuil, it was decided that Mr. H. Smith of Tobago be asked to visit Mexico and that he be requested to communicate with the Secretary with a view of preparing an estimate of the expenses.

Hevea Rubber Plants.

10. Distribution of Hevea Rubber Plants.

It was decided that 1,000 plants be handed over to the Forest Officer, and the balance to the Tobago Planters' Association, *St. Augustine* and *River Estates* and Estates in different parts of Trinidad. Details to be arranged by the Rubber Committee.

Estimates *St. Augustine* Estate.

11. C.S.M.P. 4019/10.—Estimates *St. Augustine Estate* for 1910–11. Referred back for fuller information.

The explanation of the Manager was read to the meeting and accepted.

Banana Cultivation *St. Augustine.*

12. Report on Banana Cultivation, *St. Augustine Estate.*

Postponed to next meeting.

Cotton growing in Tobago.

13. C.S.M.P. 141/10.—Correspondence with British Cotton Growing Association *re* Cotton growing in Tobago—Report of Committee.

The Board recommends the Government to carry out the experiments on the lines suggested by the Director of Agriculture for one year.

Cacao Experiments—*River Estate.*

14. Cacao experiments at *River Estate*—Report of Committee.

To be printed and circulated.

Salary Assistant Director of Agriculture.

With reference to the salary of the Assistant Director of Agriculture, His Excellency the Acting Governor stated that at the last meeting it had been fixed at £500 to £600, but on reconsideration, the Advisory Committee subsequently changed it to £600 to £700.

Chief Executive Officer.

With His Excellency's permission, it was decided that a meeting of the Advisory Committee should take place immediately after this meeting to make recommendations for the filling of the post of Chief Executive Officer of the Board.

The meeting adjourned at 11 a.m.

F. W. Urich,
Acting Honorary Secretary.

Minutes of the Board of Agriculture.

At a Special Meeting of the Board of Agriculture held in the Council Chamber on Wednesday the 31st August, 1910, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE ACTING GOVERNOR, (PRESIDENT) *in the Chair.*

THE DIRECTOR OF AGRICULTURE.

THE HON. MR. R. S. A. WARNER, K.C.

,, ,, ,, C. DE VERTEUIL.

,, ,, ,, S. HENDERSON.

MR. J. L. MOODIE.

,, E. L. SELLIER.

,, L. SEHEULT, B.SC.

,, J. W. ARBUCKLE.

THE ASSISTANT SECRETARY, MR. A. DEVENISH.

,, ENTOMOLOGIST AND ACTING HON. SECRETARY, MR. F. W. URICH.

Minutes.

The reading of the Minutes of the last meeting held on the 26th August, was postponed.

The following letters were read:—

Letters from Messrs. Thornton, de Verteuil and Greig.

(1.) From Mr. Thomas Thornton, dated 29th August, 1910, regretting his inability to attend the meeting and suggesting that the duties in connection with the office of Chief Executive Officer be circulated amongst members and voted for at the next meeting.

(2.) From Mr. Ludovic de Verteuil, dated 29th August, 1910, regretting his inability to attend the meeting.

Leave of absence to Mr. W. Greig.

(3.) Similar letter from Mr. W. Greig, dated 30th August, 1910, also applying for leave of absence from the Colony from 5th September to 23rd November, 1910.

This application was granted.

Recommendations of Advisory Committee.

The following recommendations of the Advisory Committee, dated 26th August, 1910, were laid before the Board:—

1. That the Board do appoint a Chief Executive Officer at a salary of £600 to £700 per annum.

Professor Carmody desired that his dissent be placed on record.

2. The Advisory Committee recommends that the appointment be offered to Mr. J. B. Rorer.

On the motion of Hon. Mr. Warner, seconded by the Hon. Mr. Henderson, the following substituted resolutions were carried:—

Salary of the Mycologist.

1. That the appointment at the above salary be offered to Mr. J. B. Rorer.

2. That the salary of the Mycologist be fixed at £600–£700 per annum rising by annual increments of £25.

Professor Carmody dissenting from (1.)

Hon. Mr. Henderson moved "That the increase of the Mycologist's salary take effect as from the 1st September."

Seconded by the Hon. Mr. de Verteuil.

Professor Carmody moved as an amendment that the increased salary should take effect from the date of the expiration of Mr. Rorer's present agreement.

The amendment was not seconded and the original motion was carried.

It was resolved that the appointment of Mycologist be terminable at six months notice on either side.

After thanking the Members for their attendance, His Excellency the Acting Governor adjourned the meeting to Friday, the 23rd September, at 2.15 p.m.

F. W. Urich.
Acting Hon. Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 23rd September, 1910, at 2.15 p.m.

Present :

The Director of Agriculture, (Vice-President) *in the Chair.*
,, Hon. Mr. C. de Verteuil.
,, ,, ,, S. Henderson.
Mr. J. H. Wade.
,, Louis Seheult.
,, J. W. Arbuckle.
,, H. A. Alcazar, K.C.
,, J. B. Rorer, Mycologist.
,, P. L. Guppy, Assistant Entomologist.
,, A. Devenish, Assistant Secretary.
,, F. W. Urich, Entomologist and Acting Hon. Secretary.
Also Dr. Gough and Mr. H. Smith.

The Chairman explained that His Excellency the Acting Governor was out of town and had asked him to take the Chair, and in the event of a quorum, to proceed with a certain portion of the business, leaving any contentious matter to Friday next, when a meeting would be held. His Excellency had also suggested whether there was a quorum or not, they should deal with the question of the proposal to send Mr. Smith to Mexico to report on the Castilloa cultivation. Mr. Smith was present, and it was his intention to leave by Tuesday next, if permitted to go.

The proposal to visit Mexico has already been approved by the Board and there only remained the question of the Estimate of Expenditure. The Board then went into Committee.

The Secretary read a letter from Mr. Smith, dated the 15th September, saying that he would be pleased to visit Mexico and submitting an estimate for £153 10.

Vouchers for expenditure to be submitted on his return.

The Committee approved of this estimate, and it was decided that this amount be charged to the Vote for Rubber Tapping Experiments.

The Hon. Mr. H. A. Alcazar then joined the Board and the regular business of the meeting was proceeded with. The minutes of the meetings of the 26th and 31st August, having been circulated were taken as read and were adopted after the following amendments had been made, viz. :—

In the minutes of the 26th August, page 23, Entomologist' s Report 57 to 66 " per cent." instead of " degrees. "

In the Minutes of the 31st August. (*a*) The word " substituted " was added before resolution in connection with the Hon. Mr. Warner's motion. (*b*) The " No. 1" in Mr. Warner 's resolution was substituted for "2 " after the words " Professor Carmody dissenting from."

The following letters were read:—

(1.) From Mr. L. de Verteuil, dated the 22nd September, 1910 regretting his inability to attend the meeting.

(2.) Similar letter from Mr. T. Thornton, dated 21st September, 1910

(3.) From the Secretary, Agricultural Society, dated the 21st September, *re* Officers of the Board being made *Ex-Officio* members of the Society.

Referred to the Advisory Committee.

(4.) From the Secretary, Agricultural Society, dated the 22nd, September, 1910, in connection with 10 Agricultural Experiments to be carried out by the Board 's Officers.

Referred to the Cacao Committee.

(5.) From the Hon. the Colonial Secretary forwarding C.S.M.P. No. $\frac{6002}{2740}$/10 Prospectus of the *Bulletin of the Committee of Entomological Research* " Tropical Africa. "

It was decided that the Board subscribe to this Bulletin.

The Statement of Revenue and Expenditure from 21st December, 1908, to 31st, March, 1910, having been circulated, was adopted.

The following Financial Statements were submitted :—

FINANCIAL STATEMENT.

Receipts.		
Balance on 26th August	$12,256 42	
Agricultural Tax for July	1,159 78	
,, ,, August	1,007 26	$14,923 46
Payments.		
Payments to 22nd September	$1,338 04	$1,338 04
Balance in hand		$13,585 42

SPECIAL VOTES.

Sugar Cane Experiments (Froghoppers)—($3,022)	expended to 31st August...	$634 90
Rubber Tapping Experiments—($3,000)	,, ,, ,, ...	568 88
Coconut Palm Destruction—($1,000)	,, ,, ,, ...	563 28
Exhibits at Local Shows—($200)	,, ,, ,, ...	130 45
Rubber Curing House—($1,000)	,, ,, ,, ...	nil.
River Estate Experiments—($2,880)	,, ,, ,, ...	nil.
Hand-book—($216)	,, ,, ,, ...	nil.
Blocks and Prints for Illustrations—($200)	,, ,, ,, ...	nil.
Prizes for Improved Cacao Cultivation—($960)	,, ,, ,, ...	nil.

On the motion of the Hon. Mr. C. de Verteuil, seconded by the Hon. Mr. S. Henderson, it was decided that the sum of $1,000 voted for erecting a rubber curing-house at St. Clair be struck off the Special Votes.

Recommendations of the Advisory Committee—Postponed.

The Mycologist presented a short report on the Froghopper fungus. Both laboratory and field experiments showed conclusively that the fungus in question was parasitic, killing both adult and nymph Froghoppers within a week or ten days after the time of inoculation. The fungus grows quite readily on a great variety of culture media and it was quite probable that it could be grown in large quantities for inoculating Froghoppers in the field.

With some introductory remarks the Entomologist submitted his interim report on Froghoppers and exhibited specimens of dried cane trash on which Froghopper eggs are found, also some illustrations by Mr. Guppy of the eggs in their different stages of development.

In connection with the International Congress of Entomologists and with a view of forming a branch for the West Indies, he asked the Board's permission to submit details at a future meeting.

This request was granted, details to be prepared for the next meeting.

The following documents were submitted :—

(1.) Report on Banana Cultivation at *St. Augustine Estate.*

To be printed and Circulated.

(2.) Progress Report from the Manager *River Estate* on the Cacao Experiments.

Laid on the Table.

(3.) Report of Committee on Cacao Experiments, *River Estate.*

Accepted, with the recommendation that 2,000 trees be deprived of all shade instead of 500.

(4.) Letter from Permanent Nitrate Committee, dated 12th August, 1910, in connection with their offer of £100 for experiments with Nitrate of Soda.

The Secretary was directed to accept the offer, and asked that the £100 be remitted to the Board.

(5.) C.S.M.P. No. 4655/10—Death of Mr. J. B. Carruthers.
Laid on the table.

(6.) Letter from Mr. H. E. Murray, dated 20th August, 1910, asking that Mr. Heyligers be allowed use of the Laboratory.

Referred to the Vice-President for action.

(7.) Incidental expenses in connection with Prizes for Improved Cacao Cultivation.

The Secretary was authorised to charge them to the vote of £200.

(8.) Progress Report on Rubber Tapping experiments.

Reports on the results obtained for July and August, were submitted.

The meeting then adjourned to Friday, the 30th instant, at 9.30 a.m., when the report of the Advisory Committee will be considered.

F. W. Urich,
Acting Hon. Secretary.

Minutes of the Board of Agriculture.

At a Special Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 30th September, 1910, at 9.30 a.m.

PRESENT:

HIS EXCELLENCY THE ACTING GOVERNOR (PRESIDENT) *in the Chair.*
THE HON. MR. R. S. A. WARNER, K.C.
,, ,, ,, C. DE VERTEUIL.
,, ,, ,, H. A. ALCAZAR, K.C.
MR. J. L. MOODIE.
,, L. DE VERTEUIL.
,, J. H. WADE.
,, LOUIS SEHEULT, B.SC.
,, J. W. ARBUCKLE.
,, H. E. MURRAY.
,, P. L GUPPY, ASSISTANT ENTOMOLOGIST.
,, A. DEVENISH, ASSISTANT SECRETARY.
,, F. W. URICH, ENTOMOLOGIST AND ACTING HON. SECRETARY.

The reading of the Minutes of the meeting of the 23rd instant was postponed to the next meeting. Minutes.

The following letters were read:—

(1.) From the Hon. the Colonial Secretary No. $\frac{6142/10}{2789}$ dated 27th September, 1910 forwarding resolution of the Agricultural Society that certain officers of the Board be made *ex-officio* members of the Society. Letter No. $\frac{6142/10}{2789}$ from Hon. Colonial Secretary.

Referred to the Advisory Committee.

(2.) From Professor Carmody regretting his inability to attend the meeting through ill-health and suggesting that the consideration of the duties of the Mycologist be postponed. Letter from Professor Carmody.

The following recommendations of the Advisory Committee of the 12th September, 1910, were considered in detail:—

(1.) Recommended that Messrs. Moodie and Arbuckle be appointed Members of the Advisory Committee to fill the vacancies caused by the death of Mr. Bert de Lamarre and the resignation of Captain Wright. Messrs. Moodie and Arbuckle appointed Members of the Advisory Committee.

Agreed to.

(2.) Duties of Employees of the Board.

(A.) DUTIES OF THE ENTOMOLOGIST.

(1.) He shall carry out entomological investigations and be directly responsible for the insect collections of the Board and all purely entomological apparatus. Duties of Entomologist.

(2.) He shall make a monthly report of progress, and a yearly report.

(3.) He shall assist the Mycologist in the preparation of the publications of the Board.

(4.) He shall devote his time to such special problems as the Board may direct from time to time.

Agreed to.

(B.) DUTIES OF THE ASSISTANT ENTOMOLOGIST.

Duties of Assistant Entomologist.

The Assistant Entomologist shall take up such problems as directed by the Entomologist and report directly to him.

Agreed to.

(C.) DUTIES OF THE SECRETARY.

Duties of Secretary.

(1.) He shall be responsible for all books and papers of the Board.

(2.) He shall keep the Minutes of the Board and of all Committees.

(3.) He shall keep the accounts of the Board, and pay out all monies expended on the Board's work, the signature of himself and one other member of the Board being required for cheques. All monies expended to be supported by vouchers with the exception of sums of $1.00 or less, which may be supported by a verification of the Secretary that the expenditure has been actually made and was necessary for the Board's work. A monthly statement of all ordinary and special expenditure shall be laid on the table.

(4.) He shall deal with the correspondence of the Board. Answers to letters since the last meeting shall be laid on the table for inspection of members. Any correspondence of sufficient interest shall be separately reported to the Board.

Agreed to.

(D.) DUTIES OF THE MYCOLOGIST.

Duties of Mycologist.

(1.) He shall carry out mycological investigations and be responsible for the mycological collection.

(2.) In addition to the duties required of him by the Board as Mycologist, he shall be responsible for and direct the work of the other employées of the Board. He will present monthly reports to the Director of Agriculture for the information of the Board of the work done respectively by him and them during the preceding month.

(3.) He shall be responsible for all the property of the Board.

(4.) He shall be responsible for all publications of the Board.

(5.) He shall be *ex-officio* a member of all Committees.

(6.) He shall approve of all accounts for payment.

Professor Carmody dissented from Rules 2, 3, and 6.

Postponed to next meeting.

Appointment of Secretary.

Mr. A. Devenish appointed Secretary.

(*a*.) Recommended that Mr. A. Devenish be appointed Secretary as from the first October, on 3 months probation at a salary of £200 per annum.

Post of Assistant Secretary. abolished.

(*b*.) That the post of Assistant Secretary be abolished as from 30th September.

Agreed to.

4. Publications.

Publications of the Board.

Recommended that the Publications of the Board (Reports, Circulars or Special Articles) be issued separately as soon as they are ready for publication. These may be reprinted whole or in part in the *Bulletin* if the Director of Agriculture so desires.

Agreed to.

5. Laboratories and Offices of the Board.

Recommended that Messrs. Moodie and Urich in consultation with the Director of Agriculture be requested to prepare plans and specifications for buildings to be erected at St. Clair. Laboratory and Offices for the Board.

Agreed to.

(6.) Account of A. Hoen & Co. for $419.15 for coloured plates for publications. Account of Hoen & Co.

Payment recommended.

Approved.

The Hon. Mr. Warner suggested that the Board be represented at the West Indian Agricultural Conference to take place in Demerara in January next and it was decided that this matter be put on the Agenda, for the next meeting. Representation of Board at West Indian Agricultural Conference 1911.

After thanking the Members for their attendance, His Excellency the Acting Governor adjourned the meeting to Friday, 7th October, at 9.30 a.m.

F. W. Urich,
Acting Hon. Secretary.

Minutes of the Board of Agriculture.

At a Special Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 7th October, 1910, at 10 a.m.

Present:

His Excellency the acting Governor (President) *in the Chair.*

The Director of Agriculture.

The Hon. Mr. R. S. A. Warner, K.C.

,, ,, ,, S. Henderson.

,, ,, ,, C. de Verteuil.

,, ,, ,, H. A. Alcazar, K.C.

Mr. H. E. Murray.

,, L. de Verteuil.

,, J. H. Wade.

,, Louis Seheult, B.Sc.

,, J. W. Arbuckle.

,, F. W. Urich, Entomologist.

,, A. Devenish, Secretary.

His Excellency explained that owing to indisposition of Professor Carmody (Director of Agriculture) on the occasion of the last meeting, the consideration of the Advisory Committee's proposal touching the duties of the Mycologist, had been postponed in order that the Director might put forward his reasons of objection to the Committee's recommendation.

The Minutes of the meeting of the 23rd September, 1910, having been circulated, were taken as read and confirmed. Minutes.

The Hon'ble Mr. Henderson, seconded by the Hon'ble Mr. C. de Verteuil, moved that the following recommendations of the Advisory Committee of the 12th September, 1910, be adopted, viz.:—

Duties of Mycologist.

Duties of Mycologist.

(1.) He shall carry out mycological investigations and be responsible for the mycological collection.

(2.) In addition to the duties required of him by the Board as Mycologist, he shall be responsible for and direct the work of the other employees of the Board. He will present monthly reports to the Director of Agriculture for the information of the Board of the work done respectively by him and them during the preceding month.

(3.) He shall be responsible for all the property of the Board.

(4.) He shall be responsible for all publications of the Board.

(5.) He shall be *ex-officio* a member of all Committees.

(6.) He shall approve of all accounts for payment.

Professor Carmody (Director of Agriculture) said he very much regretted his inability to attend the last meeting of the Board. Although not feeling well, he came to town, and had made every effort to attend, but was eventually obliged to return home before the meeting began. He must apologise to members, because it was a special meeting at which they were to deal with one important point. In the course of the Advisory Committee's report, it was stated that he had objected to Nos. 2, 3 and 6 of the duties of the Mycologist, and he did so on the ground that the Mycologist should be employed exclusively on mycological work. It was the long experience of everyone working in any branch of science, to know that if an investigator's ordinary duties were interfered with by even a small amount of clerical work, there was much less progress made. In nearly every scientific establishment of any size, one man was always set apart for making investigations in order that he might be able to devote his whole attention to them. He said that if the Mycologist was employed in supervising the work of the Board's officers and to do clerical work, he was quite satisfied that much more important work would be neglected; and it would be far better in the interest of the colony that his whole attention be given at the present time to the disease of bud-rot, and other diseases of coconuts, rather than any fraction of his time be taken away from them. They had been for years waiting for a Mycologist in order to investigate some of the worst diseases in connection with agricultural work; and now they had got a man who was thoroughly competent to do it, it seemed to him to be a bad arrangement to take that officer away from scientific work and give him either clerical work or the supervision of other officers. His other objection was because it was a departure in principle from the working of the Board hitherto. He would mention, for the benefit of members who were not conversant with the history of the Board from the start—that the original idea was that the Department of Agriculture as re-arranged, should be the permanent machinery for carrying out experimental work in connection with agriculture. The funds were to be provided by the Board, which would have complete control over them. The funds of the Board did not and could not include any large sums for salary, and it was intended undoubtedly, that the machinery which was already there and for which no salaries were required, would be the machinery used for carrying out the experiments. Since the Board was started, it was found necessary to employ two special officers for temporary work, and these were the only

officers ever intended to be appointed. Those officers were Specialists in their own line, and there was no necessity for supervision over them. That scheme had worked from the beginning of the establishment of the Board until last November, and the work of the Board was carried out on departmental lines, and he thought he could safely say there was no dissatisfaction with the working of it up to that time. Subsequently, there was some modification, but still the principle remained that the work of the Board was carried out in co-operation with the Department of Agriculture; and as His Excellency knew, in a despatch to the Secretary of State, His Excellency had assured His Lordship that the officers of the Board whilst so employed, would be under the sole direction of the Director of Agriculture. And that was done at a time when criticism of the scheme was so severe, that probably if His Excellency had not made that statement, the Board's Ordinance would not have been passed. The Board had full power to deal with its funds, and in other places there were Boards working in a similar way. The money was to be provided and allocated by the Board which saw that it was spent in the best way possible. Now, the best possible way of spending money, was to spend it through officers who are accustomed to spend it in that class of work. It was very necessary in scientific work that a man should have experience of the cost of experiments and apparatus; and the Department of Agriculture as it was formed, had that experience, which was no doubt an advantage to the Board. Then as the Board had considerable control over the Department of Agriculture in many ways (and rightly so) they could always find fault with the spending of the money by the Department if they had reason to do so, and as the head of the department would always be an officer in a responsible position, they would always have the satisfaction of knowing that their money was spent in the best possible manner. He did not think that any such Board could be properly worked, if its expenditure was made through officers holding a temporary position, and he was sure it would be found to be a failure in a short time. The amount of supervision that was given to the Mycologist was purely nominal. There was a very small amount of work included in those regulations, but of course, he supposed it was intended afterwards that they would be extended. That was one of the difficulties which one had to deal with, because the Department had to be run along certain lines, and the Board could alter its policy at any moment if it thought it advisable to do so, and the Department would always be unable to know definitely what was required of it from time to time. As he had mentioned, the duties of supervising the Board's officers were very light; they were almost nominal, and the supervision of the Entomologist by the Mycologist was practically nothing at all and not necessary, whilst the clerical work to be given him in connection with the property and accounts of the Board, he (the Director) was satisfied should not be given at all. He was obliged in the circumstances, to mention to the Board, that it would be necessary for him as being the officer in direct charge of the working of the Department of Agriculture to report to the Secretary of State through the Governor, the fundamental change that had been proposed. As he would have to do that, he desired only to lay impartially before the Board his views on the question. He did not intend to vote for, or dissent from the regulations any further. If it was the wish of the Board to carry them out, and if authorized by the Secretary of State he would do his best to carry them out in a faithful manner. It had always been his experience during the thirty-three years of his official life, that the proper way of any public servant was, to carry out his duties according to the wish of the majority of those at the time who had the ruling power. In the same way if the Board believed it was necessary that those alterations should be made, and the sanction of the Secretary of State obtained, he would certainly carry them out as he

had said, to the best of his ability. At the same time, he must remind them again that he believed it would be a complete failure, and would interfere with investigations which were far more important and necessary.

Mr. Carl de Verteuil said he was quite sure that the Board would recognize the failure if it came and would go back to the old position, but all they asked was that the scheme be given a fair trial, especially as the Director of Agriculture would faithfully carry it out.

The Acting Attorney-General said that necessarily in all things there must be differences of opinion, and although the views of the Board were not shared by Professor Carmody, yet they welcomed the last expression that fell from him, viz.:—the desire to cordially and loyally help to give effect to the regulation although he did not think they would work well. He was perfectly satisfied that if the Director of Agriculture did that, he would find it quite unnecessary to refer to the Secretary of State. The fundamental idea of the existence of the Board was, that here for the first time (and it was a point on which the late Sir Henry Moore Jackson congratulated himself and the Colony) people came forward and said "we are willing to tax ourselves in the interest of agriculture, if we have control of the moneys which will be raised in the way proposed." That was all that the Board aimed at. He could assure Professor Carmody—speaking for himself and the other members of the Board as far as he knew their views—that they looked forward to his co-operation, and they begged to assure him that in whatever branch of work or investigation he was asked to take charge of, he would have absolute control. Professor Carmody need not suppose that they were going to do such a foolish thing as to ask him to take control of a certain branch of the work, and then interfere with him in the carrying out of the experiments. They felt sure that if the distribution of the business as recommended by the Advisory Committee, was given a fair chance it would work well and in a short time Professor Carmody would recognize it, and hereafter the Board ought to work successfully, aided immensely by the energy and ability of the Director of Agriculture.

The motion for the adoption of the Advisory Committee's report was put to the vote and carried.

Messrs. Rorer Urich Guppy, and Caracciolo appointed members Agricultural Society.

On the motion of Professor Carmody, seconded by Mr. L. Seheult, the following recommendation of the Advisory Committee was adopted, viz.:—

> That Messrs. J. B. Rorer, F. W. Urich, P. L. Guppy, and H. Caracciolo Jr., be allowed to accept the Agricultural Society's resolution to be elected *ex-officio* members.

Whether Officers of the Board be appointed members *ex-officio* or otherwise, of the Society.

The following resolution of the Agricultural Society was referred to the Advisory Committee, viz.:—

> "That in the opinion of the Society it is desirable that the Officers of the Board of Agriculture should become members *ex-officio* or otherwise, and when convenient should attend the meetings."

Mr. Urich appointed representative of Board at West Indian Conference, 1911.

Representation of the Board at the West Indian Conference to be held in Demerara in January, 1911.

The Hon. Mr. C. de Verteuil, seconded by the Hon. Mr. S. Henderson, proposed that Mr. F. W. Urich be appointed delegate to represent the Board.

Agreed to.

The meeting then terminated.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 21st October, 1910, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE ACTING GOVERNOR (PRESIDENT) *in the Chair.*

THE DIRECTOR OF AGRICULTURE.

THE HON. MR. R. S. A. WARNER, K.C.

,, ,, ,, S. HENDERSON.

,, ,, ,, C. DE VERTEUIL.

,, ,, ,, W. G. KAY.

MR. H. E. MURRAY.

,, L. DE VERTEUIL.

,, E. L. SELLIER.

,, LOUIS SEHEULT, B.SC.

,, J. W. ARBUCKLE.

,, JAS. BLACK.

,, W. C. JARDINE.

,, J. B. RORER, MYCOLOGIST.

,, F. W. URICH, ENTOMOLOGIST.

,, P. L. GUPPY, ASST. ENTOMOLOGIST.

,, L. A. BRUNTON, AGRICULTURAL INSPECTOR.

,, A. DEVENISH, SECRETARY.

Minutes.

The Minutes of the meetings of the 30th September and 7th October having been circulated, were taken as read and confirmed.

The following 3 letters were read:—

Letters from Rev. Dr. Morton, Messrs. Moodie and Thornton.

From the Rev. Dr. J. Morton, Messrs. J. L. Moodie and T. Thornton regretting their inability to attend the meeting.

Financial Statement.

The Financial Statement was submitted:—

FINANCIAL STATEMENT.

Receipts:		
Balance on 23rd September	$ 13,585 42	
Agricultural Tax for September	490 34	$ 14,075 76
Payments:		
Payments to 20th October	$ 2,286 28	$ 2,286 28
Balance in hand		$ 11,789 48

Special Votes.

Sugar Cane Experiments (Froghopper) ($3,022) expended to 30th September	$ 689 93
Rubber Tapping Experiments—($3,000) expended to 30th September	1,310 65
Coconut Palm Destruction—($1,000) expended to 30 Sept. ...	663 97
Exhibits at Local Shows—($200) expended to 30th September	130 45
River Estate Experiments—($2,880) ,, ,, ,, ...	nil.
Hand Book—($216) ,, ,, ,, ...	nil.
Blocks and Prints for Illustrations—($200) ,, ,, ...	nil.
Prizes for improved Cacao Cultivations—($960) ,, ...	nil.

Recommendations of Advisory Committee.

(2.) The Hon. Mr. Warner in moving the adoption of the Report of the Advisory Committee, seconded by the Hon. Mr. C. de Verteuil, explained that it was intended that meetings of the Advisory Committee should take place some days before the meeting of the Board, so that members should have in their hands the conclusions of the Advisory Committee for them to consider. On the present occasion, it was found that one particular item (The Plant Protection Ordinance) was urgent and no convenient time could be found except that day, without unnecessarily asking members of the Committee to come to town oftener than was necessary; so that on the present occasion it was found expedient to hold the Advisory Committee meeting on the same day as the meeting of the Board. He mentioned that, in order that it should not be thought there was any intention to do otherwise than was originally laid down, but the present departure was due to the exigency of circumstances.

The following report of the Advisory Committee was then adopted :—

1. Letter from the Secretary Agricultural Society *re* other officers of the Board becoming members *ex-officio* or otherwise.

   Recommended that only the four officers already named should become members.

2. C.S.M.P. 4911/07, Draft of Plant Protection Ordinance.

   Recommended that it be printed and circulated among members of the Board and brought up at the next meeting.

Mr. Rorer also appointed delegate to represent Board at West Indian Conference to be held in Demerara.

3. *Re* Delegates to West Indian Conference to be held in Demerara in January, 1911.

   Recommended that Mr. J. B. Rorer, should also be sent as a delegate, and should extend his visit to Suriname to make observations on the Witch Broom disease of Cacao.

4. *Re* Publications of the Board.

   Recommended that as soon as printed they are to be circulated by the Department of Agriculture.

5. Application from Mr. Lewis, Clerical Assistant, for an increase of pay.

   Not recommended.

Mycologist's Report.

(3.) The Mycologist exhibited a galvanized sheet containing the Froghopper fungus which showed the method used for growing it in large quantities. More or less air tight cabinets can be made containing a number of shelves on each of which the fungus may be grown in practically pure culture. Boiled rice is a very good medium on which to grow the fungus. It is hoped that by following this method, sufficient spores can be obtained to dust over the cane-fields for the purpose of infecting the insects. It might also be advisable to dust spores over pen manure as it is being taken out to the fields, for in this way the spores may be brought in contact with the nymphs on the cane roots.

Mr. Plummer is now carrying out the work of destroying coconut palms along the north coast. As soon as he has finished that district he will go to Tobago and continue the work there. Up to the present he has destroyed about 15,000 trees.

The cocoa spraying experiments are being continued. Although the pickings have been light during the past three months on account of the heavy change of leaf, the results of the sprayings are still showing up well.

At Sangre Grande 3,000 more pods have been picked from 500 sprayed trees than from the corresponding number of unsprayed trees since the first of last February, while at Guanapo, 2,287 more sound pods have been picked from the sprayed trees.

The Entomologist said that since the last meeting he had prepared boxes, showing all stages of the Froghopper from the egg to the perfect insect, for distribution to Sugar Estates, so that all interested would be able to identify the insects. It had been reported that Froghoppers were increasing in numbers, but it was not stated in which stage. From catches for the last three months, adult froghoppers were more numerous in August and it was no doubt the spittle stage that was on the increase. During September fewer adults were caught than the month before. (28,000 adults were caught in July, 49,000 in August and 34,000 in September; all in one field.)

Entomologist's Report.

With some introductory remarks the Assistant Entomologist laid his Preliminary Report on the Cacao beetle before the Board, and exhibited some small pieces of branches containing the eggs.

(5.) Report of Manager on Banana Experiments, *St. Augustine Estate.*

Postponed until the Director gets the figures, when they are to be printed and circulated.

Report of Manager Banana Experiments *St. Augustine.*

(6.) Letter from the Entomologist *re* formation of Committee of Entomological Research for the West Indies.

It was decided that a copy of the letter be sent to the Government for transmission to the Imperial Commissioner of Agriculture.

Re Formation of Committee of Entomological research for West Indies.

(7.) C.S.M.P. 4911/07.—Draft of Plant Protection Ordinance. Report of Committee.

Mr. Warner moved that it be brought up at the next meeting.

Plant Protection Ordinance.

(8.) Plans for New Buildings for Board of Agriculture.

Referred back to the Committee to prepare an estimate of the cost.

Plans for New Buildings for Board of Agriculture to be erected at St. Clair.

(9.) C.S.M.P. 3920/07.—Truck System. Report of Committee. Laid on the table.

Truck System.

(10.) C.S.M.P. 4515/10.—Temporary vacancies on the Board.

Appointment of Rev. Dr. J. Morton in place of Mr. E. André and Messrs. H. A. Alcazar, Jas. Black and W. C. Jardine to act during the absence of Messrs. D'Abadie, Fenwick and Bain.

Laid on the table.

Temporary Vacancies on the Board.

(11.) Purchase of Agricultural Tools (Catalogue received).

Laid on the table.

Catalogue of Agricultural tools.

(12.) Progress Report Cacao Experiments *River Estate.*

Laid on the table.

Progress Report cacao Experiments *River Estate.*

(13.) Progress Report Rubber Experiments.

A Report of the result obtained for September was submitted.

Progress Report Rubber Experiments.

Report of Cacao Committee on Prize Competition for Improved Cacao cultivation.

(14.) Report of Cacao Committee.

On the motion of the Hon. Mr. C. de Verteuil, seconded by the Hon. Mr. S. Henderson, the following report of the Cacao Committee was adopted, viz. :—

That the Director of Agriculture and two other members of the Cacao Committee be appointed to deal with the Prize Competition for Improved Cacao Cultivation ; that Mr. D. C. Plummer, Agricultural Inspector, be employed on the Prize Scheme from the 1st of January, 1911, and that Mr. L. A. Brunton should go on meanwhile with the arrangements for the competition in his district; that Manzanilla and Brasso be the two centres for the 1911 competition, the Prizes for which will be distributed in December of that year.

On the motion of Professor Carmody, seconded by the Hon. Mr. S. Henderson :—

The Hon'bles Messrs. A. Warner and C. de Verteuil were appointed to act with the Director.

After thanking the members for their attendance, His Excellency the Acting Governor adjourned the meeting to Friday, the 18th November, at 2.15 p.m.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 18th November, 1910, at 2.15 p.m.

Present :

His Excellency the acting Governor (President) *in the Chair.*
The Director of Agriculture.
,, Hon. Mr. R. S. A. Warner, k.c.
,, ,, ,, C. de Verteuil.
,, ,, ,, W. G. Kay.
Mr. J. D'Abadie.
,, J. H. Wade.
,, L. Seheult, b.sc.
,, J. J. McLeod.
,, W. Greig.
,, J. W. Arbuckle.
,, J. Black.
Rev. Dr. J. Morton.
Mr. J. B. Rorer, Mycologist.
,, F. W. Urich, Entomologist.
,, P. L. Guppy, Assistant Entomologist.
,, J. McInroy, Manager Government Farm.
,, A. Devenish, Secretary.

Minutes.

The Minutes of the meeting of the 21st October, having been circulated, were taken as read and confirmed.

The following two letters were read:—

From Messrs. W. C. Jardine and Thomas Thornton, regretting their inability to attend the meeting. Letters from Messrs. Jardine and Thornton.

The Financial Statement was submitted. Financial Statement.

FINANCIAL STATEMENT.

Receipts.		
Balance on 21st October	$11,789 48	
Agricultural Tax for October	517 90	
Permanent Nitrate Committee's cheque for Experiments	483 00	$12,790 38
Payments.		
Payments to 18th November	$ 1,293 20	1,293 20
Balance in hand		$11,507 18

Special Votes.	
Sugar Cane Experiments (Froghopper) ($3,022) expended to 31st October	$ 750 49
Rubber Tapping Experiments—($3,000) expended to 31st Oct....	1,394 21
Coconut Palm Destruction—($1,000) ,, ,, ...	763 97
Exhibit at Local Shows—($200) ,, ,, ...	130 45
Prizes for Improved Cacao Cultivations...($960) expended to 31st October)	24 75
River Estate Experiments—($2.880) expended to 31st October ...	nil.
Hand Book—($216) expended to 31st October	nil.
Blocks and Prints for illustrations—($200) expended to 31st October	nil.

The following recommendations of the Advisory Committee were then adopted. Recommendations of Advisory Committee.

1. On the motion of the Hon. Mr. R. S. A. Warner seconded by Mr. J. d'Abadie C.S.M.P. 626/10/3079 in connection with Messrs. Urich and Guppy's pensions, while employed by the Board. *Re* Messrs. Urich and Guppy's Pension.

   Recommended that the proposal in paragraph 3 of the letter be submitted to the Board for adoption, viz. :—" That this Board agrees to recognise a prospective liability for a proportionate part of the ultimate pensions of the Officers named."

(2.) On the motion of the Hon. Mr. R. S. A. Warner seconded by the Hon. Mr. C. de Verteuil *re* estimate of cost of new building for Board of Agriculture (£2,300). Estmate of cost new building for Board of Agriculture.

   Recommended that the Government be asked to expend the necessary amount required to erect a building for which the Board will pay a fixed amount annually to cover rent, sinking funds and minor repairs.

(3.) On the motion of Professor Carmody seconded by Mr. L. Seheult *re* Professor Carmody's application that the Board provides its telephone and washstand for the use of the Board's Officers at St. Clair. *Re* Board's telephone, &c.

   Recommended.

(4.) *Re* Professor Carmody's application that the office now occupied by the Secretary be returned to the Department for the use of the Department's Clerk. *Re* Secretary's office.

   Recommended, the Secretary to occupy the desk in the Board's Laboratory now used by the Acting Curator who will have a desk put in the Office of the Officer-in-Charge, or elsewhere.

Dr. Gough's application for the Assistant Entomologist Services to do some sketches.

(5.) *Re* Dr. Gough's applications through Mr. Moodie and the Vice-President for the services of the Assistant Entomologist to do some sketches for him, and for the loan of a Spraying machine.

Recommended, and the Vice-President was asked to reply to Dr. Gough informing him that the Board will be only too willing to give him all assistance he requires, as was promised him at the meeting of the Board held on the 29th July last.

The following papers were submitted :—

Engagement of experienced Entomologist in connection with Froghoppers.

(1.) C.S.M.P. 6702/08.—Engagement of an experienced Entomologist for six months from April to investigate Froghoppers.

The Hon. Mr. W. G. Kay moved seconded by Mr. J. J. McLeod that the question of the Board's contribution towards the expenses of Dr. Gough's visit be postponed until the termination of his engagement.

Agreed to.

Manager *River Estate* application for increase of pay.

(2.) C.S.M.P. 153/10.—Manager, *River Estate*, application for an increase of salary.

It was decided that the Board recommend the Government to increase his salary on the incremental scale of £150 to £200 per annum from the 1st October, 1910.

Draft of Plant Protection Ordinance.

(3.) C.S.M.P. 4911/07.—Draft of Plant Protection Ordinance and Report of Committee.

The Hon. Mr. C. de Verteuil moved seconded by the Hon. Mr. W. G. Kay that the Government be asked to arrange for its introduction in Council.

Agreed to.

Mycologist's report.

4. The Mycologist said that some action should be taken to ensure the inspection and disinfection of the Hevea seeds which were being imported into the Colony in order to prevent, or at least delay the introduction of the fungus diseases which were prevalent in the East. Several of the diseases were caused by hymenomycetous fungi which gave off spores in enormous quantities; these spores were very light and were carried long distances by the wind and it was not unreasonable to suppose that many of them might be present on not only the seeds, but also on the material used for packing. He suggested that it would be well for all the material in which the seeds were packed be burnt, and the seeds themselves dipped in Bordeaux mixture before planting.

It was decided that the Mycologist should see the importers and point out the risk run, and the Secretary was directed to submit the matter for the consideration of the Government.

Entomologist's report.

5. The Entomologist said that the experiments in connection with Froghoppers were going on nicely. The plant canes were not affected and of the ratoon fields one of which showed signs of blight was recovering.

Blight had appeared in Chaguanas in two small fields and it seemed to be spreading. While carrying on the work in connection with Froghoppers he had observed the different kinds of borers in canes which appeared to be different in various localities, for instance at Chaguanas *Diatraea saccharalis* was

common and attacked cane and bamboo grass. Some Diatraea gru-gru worms were found in the canes at San Fernando, Canella was common at Caroni and was only found on cane, but he thought their presence there was accidental and due to fermenting cane roots, some detailed drawings and descriptions of the pest would be published later on.

The Assistant Entomologist exhibited some beetles and cacao leaves damaged by them and he was pleased at being able to say that they were not in as great numbers as formerly.

6. Letter and Cheque for £100 from the Permanent Nitrate Committee for Experiments with Nitrate of Soda on cacao and sugar estates. Permanent Nitrate Committee's cheque for experiments.

Referred to Advisory Committee.

7. Letter of resignation from Mr. R. A. Lewis, Clerical Assistant, from the 30th instant. Mr Lewis' resignation as Clerical Assistant.

Accepted.

8. Letter from Mr. Plummer, Agricultural Inspector, for $15 out of pocket expenses incurred while in Toco, etc., on coconut work. Acting Inspector Plummer's application for extra expenses incurred.

Granted.

9. Progress Report on Rubber Tapping (Castilloa). Progress report—Rubber tapping (Castilloa).

The Director of Agriculture showed several samples of Rubber from Verdant Vale and Tortuga, and a report of the result obtained for October was submitted.

10. Banana Cultivation, Manager's Reports. Report of Manager—Banana Cultivation.

Having been printed and circulated were laid on the table.

11. Mr. H. E. Murray's motion :— Mr. Murray's motion *re* Mr. Tripp's letter to W.I. Circular on Board's allowance.

"Has it been noticed that Mr. Tripp in his letter to the "*West India Committee Circular* dated September "15th, stated :—The special taxation of the Board "amounted for the first quarter of the present year "to $25,000, and with an endowment of this mag-"nitude good work should, and doubtless would, be "in evidence before long?"

"As this statement is incorrect and misleading, I move "that it be brought to Mr. Tripp's notice, and that "he be asked to correct it, and be more careful in "future when quoting figures."

A letter from Mr. Tripp was read stating that the error referred to was noticed as soon as the *West India Committee Circular* in which it appeared reached this Colony and it was corrected by the first opportunity viz :—by Mail leaving here on 18th October last.

A letter from Mr. Murray was also read expressing his pleasure to know that Mr. Tripp had corrected the error.

After thanking the members for their attendance, His Excellency the Acting Governor adjourned the meeting to Friday the 16th December.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 16th December, 1910, at 2.30 p.m.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (PRESIDENT) *in the Chair.*
THE HON. G. T. FENWICK, C.M.G.
„ „ R. S. A. WARNER, K.C.
„ „ C. DE VERTEUIL.
„ „ S. HENDERSON.
„ „ W. G. KAY.
MR. J. D'ABADIE.
„ H. E. MURRAY.
„ J. L. MOODIE.
„ J. J. MCLEOD.
„ J. W. ARBUCKLE.
„ L. SEHEULT, B.SC.
„ W. GREIG.
„ J. H. WADE.
REV. DR. J. MORTON.
MR. J. B. RORER. MYCOLOGIST.
„ F. W. URICH, ENTOMOLOGIST.
„ A. DEVENISH. SECRETARY.

Minutes.

The Minutes of the meeting of the 18th November, having been circulated, were taken as read and confirmed.

Letters from Messrs. Carmody, de Verteuil and Jardine.

The following three letters were read :—

From Professor Carmody, Messrs. L. de Verteuil and W. C. Jardine, regretting their inability to attend the meeting.

Financial Statement.

The Financial statement was submitted.

FINANCIAL STATEMENT.

Receipts.	
Balance on 18th November	$11,507 18
Payments.	
Payments to 16th December	1,099 00
Balance in hand	10,408 18
Special Votes.	
Sugar Cane Expts. (Froghopper) ($3,022) expended to 30th November	$ 802 36
Rubber Tapping Expts. ($3,000) Expended to 30th November ...	1,447 51
Coconut Palm Destruction ($1,000) „ „ „ ...	863 97
Exhibits at Local Shows ($ 200) „ „ „ ..	130 45
Prizes for improved Cacao Cultivations ($ 960) expended to 30th November	24 75
River Estate Expts. ($2,880) Expended to 30th November...	nil.
Handbook ($216) „ „ „ ...	nil.
Blocks and Prints for Illustrations ($ 200) expended to 30th... November	nil.

Letter from Mr. W. C. Jardine *re* Agricultural Tax Ordinance.

The following papers were submitted :—

1. Letter from Mr. W. C. Jardine, *re* Agricultural Produce Tax Ordinance.

It was decided that the figures in the present Ordinance be allowed to stand as they are for 1911. The Secretary

was directed to bring it up in October, 1911, when the figures for the following year can be discussed.

2. C.S.M.P. 214/09.—In connection with Mr. Urich's appointment as Entomologist for two years, from 16th January, 1909 to 15th January 1911. Mr. Urich re-appointed Entomologist.

The Hon. C. de Verteuil moved, seconded by the Hon. S. Henderson, that Mr. Urich be re-appointed Entomologist for a further period of two years from the 16th January, 1911, subject to the Governor's approval.

Agreed to.

3. C.S.M.P. 626/10.—In connection with Mr. Guppy's appointment as Assistant Entomologist for eleven months, from 1st February, 1910, to 31st December, 1910. Mr. Guppy re-appointed Assistant Entomologist

The Hon. C. de Verteuil moved, seconded by the Hon. S. Henderson, that Mr. Guppy be re-appointed Assistant Entomologist for a further period of six months, from 1st January, 1911, subject to the Governor's approval.

Agreed to,

4. C.S.M.P. 2473/10. In connection with Mr. Devenish's appointment as Assistant Secretary from 1st June to 31st December, 1910. Mr. Devenish re-appointed Secretary.

The Hon. G. T. Fenwick moved, seconded by the Hon. R. S. A. Warner, that Mr. Devenish be re-appointed Secretary for a further period of one year from the 1st January, 1911, subject to the Governor's approval.

Agreed to.

5. C.S.M.P. 7345/10. Destruction of Mongoose. For suggestions as to best methods for destroying them. Destruction of Mongoose.

After discussion it was postponed to the next meeting for further consideration.

6. Reports of Cacao Standard's Committees, Cacao Standard's report.

To be printed and circulated among the Members.

7. Letter from Mycologist *re* Publications of the Board of Agriculture. Publications of the Board.

Referred to the Advisory Committee.

8. The Mycologist said that as Mr. Plummer was finishing the work of destroying diseased coconut palms, for which the Board voted the sum of $1,000, he wished to take this opportunity of expressing his appreciation for the way in which the work had been carried out. The task had been a difficult one, as Mr. Plummer was not working under any Ordinance; he simply had to use his powers of persuasion with the people. In his complete round of the Island he had met with no opposition, and had cut down over 17,000 diseased trees. He left for Tobago last Monday, and is now doing the work there. Mycologist's report.

The study of coconut diseases was still being continued in the field and in the Laboratory. Bud-rot had been produced artificially, by inoculations with pure cultures of bacteria. The root disease however, was proving to be a more difficult problem as no definite fungus had been found constantly associated with the diseased roots, and the evidence seemed to point to the fact that the diseae was due to some unfavourable soil conditions.

The Cacao spraying experiments were still being continued and the number of trees had been increased both at Guanapo and Sangre Grande.

Entomologist's report.

9. In connection with his report the Entomologist said that with regard to beetles and bud-rot of the Coconut palm, he had studied an outbreak of this disease at Laventille early in 1909, and at that time he had come to the conclusion that beetles were not the cause of Bud rot. There were several kinds of beetles to be found on dead Coconut palms, some were harmless scavengers and others were attracted by the diseased trees. The palm weevils (*Rhynchophorus palmarum*) only attacked felled trees on the ground, whereas the Bearded Weevils (*Rhina Barbirostis*) attacked trees that were standing. The last named beetle was more dangerous than the others as it could more easily attack healthy trees. Up to now, however, it had not been observed on any healthy trees and it was significant that on trees attacked by Bud-rot, the Bearded Weevil laid its eggs near the top and on the trees affected by Root diseases near the base of the tree. It would appear as if the particular smell of the disease attracted them. The cause of the spread of Bud-rot was still a matter for investigation, but he thought that *Diptera* were more likely to be carriers of the disease, than beetles. There was a Caterpillar (*Brassolis sophorae*) that had been quite injurious to Coconut palms in British Guiana and Panama by stripping them of their leaves. There were not many in Trinidad but still they had been reported from Icacos, Matura, New Lands and the Naparimas and he thought they should be destroyed whenever seen. An illustrated Bulletin on these pests would be published shortly. As a result of the destruction of the Royal Palms by these caterpillars the Palm Weevil *Rhyncophorus palmarum* had increased in the Naparimas and had attacked plant canes in some localities.

The Froghopper experiments were progressing favourably but much could not be done now owing to the high canes. Blight had appeared in some fields of ratoon canes in Caroni and Chaguanas.

Mr. Plummer—Leave of absence.

10. Mr. Plummer's (Agricultural Inspector) application for leave of absence on Medical certificates from 21st November to 10th December.

Approved.

Mr. Guppy's application for remuneration for illustrations.

11. Mr. Guppy's (Assistant Entomologist) application for extra remuneration for illustrations for *Bulletin*, etc.

Referred to the Advisory Committee.

Letter from Dr. Gough—*re* services of Mr. Guppy.

12. A letter was read from Dr. L. Gough thanking the members of the Board for allowing Mr. Guppy to do some drawings for him.

After thanking the members for their attendance, and wishing them all a happy Christmas and pleasant New Year, His Excellency the Governor adjourned the meeting to Friday, the 20th January, 1911.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 20th January, 1911, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE GOVERNOR. (PRESIDENT) *in the Chair.*
THE DIRECTOR OF AGRICULTURE.
THE HON. G. T. FENWICK, C.M.G.
,, ,, R. S. A. WARNER, K.C.
,, ,, S. HENDERSON.
,, ,, C. DE VERTEUIL.
LIEUT.-COL. COLLENS, V.D.
MR. J. D'ABADIE.
,, H. E. MURRAY.
,, L. DE VERTEUIL.
,, WM. GREIG.
,, J. H. WADE.
,, LOUIS SEHEULT, B.SC.
,, THOS. THORNTON.
,, J. W. ARBUCKLE.
REV. DR. J. MORTON.
MR. J. B. RORER, MYCOLOGIST.
,, F. W. URICH, ENTOMOLOGIST.
,, P. L. GUPPY, ASST. ENTOMOLOGIST.
,, HARRY SMITH OF TOBAGO.
,, W. E. BROADWAY, OFFICER IN CHARGE, BOTANIC STATION,
DR. L. H. GOUGH.

The Minutes of the meeting of the 16th December, having been circulated, were taken as read and confirmed. Minutes.

Professor Carmody said that the Hon. W. G. Kay had asked him to state his regret at being unable to attend the meeting on account of being indisposed. Mr. Kay, unable to be present.

The Financial Statement was submitted. Financial Statement.

FINANCIAL STATEMENT.

Receipts.		
Balance on 16th December	$10,408 18	
Agricultural Tax for November	1,056 76	
,, ,, December	924 04	$12,388 98
Payments.		
Payments to 20th January, 1911		2,185 48
Balance in hand		$10,203 50

Special Votes..	
Sugar Cane Experiments (Froghopper) ($3,022) expended to 31st December	$ 823 14
Rubber Tapping Experiments ($3,000) expended to 31st Dec. ...	1,474 65
Coconut Palm Destruction ($1,000) ,, ,, ...	879 81
Exhibits at Local Shows ($200) ,, ,, ...	130 45
Prizes for Improved Cacao Cultivation ($960) expended to 31st December	36 10
River Estate Experiments ($2,880)	800 85
Handbook ($216) expended to 31st December	nil.
Blocks and Prints for Illustrations ($200) expended to 31st Dec.	nil.

Recommendations of Advisory Committee.

On the motion of Professor Carmody, seconded by the Hon. C. de Verteuil, the following recommendations of the Advisory Committee, dated 4th January, 1911, were adopted :—

Officer to visit locality when report of deadly disease is received.

1. C.S.M.P. 6489/10. Outbreak of a deadly disease, Coconut trees, St. Quintin.

Recommended that in such cases an officer should visit the locality as soon as possible after a request has been received from a Planter, in connection with plant disease.

Plans for Board of Agriculture Buildings.

2. C.S.M.P. 7434/10. Plans for New Buildings for Board of Agriculture.

Recommended that the Director of Public Works be thanked for his Minute, and be further asked if he will be good enough to let the Board have a plan for a building as per his estimate of £1,750.

Permanent Nitrate Committee's Experiments.

3. £100—from Nitrate Committee for Experiments with Nitrate of Soda.

Recommended that £50 be given to the Director of Agriculture, and £50 to the Mycologist, to carry out the Experiments.

Mr. Guppy's application for remuneration for illustrations, &c.

4. Mr. Guppy's (Assistant Entomologist) application for extra remuneration for illustrations for Bulletin, etc.

Recommended that Mr. Guppy be heartily thanked for the good work he did, and be informed that the Board regrets being unable to grant him any remuneration as it is considered part of his duties as Assistant Entomologist.

23 tons manure received for experiments at *River Estate* and elsewhere.

5. In connection with 23 tons of manure received for Experiments to be carried out at *River Estate* or elsewhere.

Recommended that it be applied to Cacao and Sugar in different parts of the Island and that the Director of Agriculture be allowed a vote of £100 for expenses, as to assistance, etc.. in carrying out same, it being understood that the Planters were to supply the labour for applying the manure.

Committee to deal with manuring experiments.

Professor Carmody proposed that Messrs. L. de Verteuil, H. E. Murray, J. L. Moodie, and L. Seheult be appointed as a Committee to deal in connection with the manuring Experiments.

Agreed to.

The following papers were submitted to the Board :—

Mr. Smith's Report on visit to Mexico in connection with Rubber.

1. Mr. Smith's report on visit to Mexico, in connection with *Castilloa elastica* Rubber.

The report having been printed and circulated, was presented. Mr. Smith emphasized a few of the most important points, answered several questions asked by the members of the Board and exhibited photographs, samples of rubber and the tapping knife generally used in Mexico.

Professor Carmody moved a vote of thanks to Mr. Smith for the excellent report submitted, and said that he was sure that all the members would join with him in thanking Mr. Smith.

His Excellency said that it gave him much pleasure to accord Mr. Smith their appreciation of his services.

2. Reports of Cacao Standard's Committee. Cacao Standard's Committee Report.

The reports of the Committee on the Standardization of Cacao were printed and circulated.

Postponed to next meeting for further consideration.

3. Publication of hand books relating to British West Indian Colonies. Publication of Handbooks B.W.I. Colonies maps received.

M.P. 1396/10. In connection with 3,000 copies of maps ordered, was laid on the table.

4. Letter from Colonial Secretary in connection with one million Para Rubber seeds ordered by telegram for the Department of Agriculture. Para Rubber seeds ordered by Department of Agriculture.

The Board recommended that the order be countermanded by telegram.

5. C.S.M.P. 7345/10. Destruction of Mongoose. For suggestion as to best methods of destroying them. Destruction of Mongoose.

Postponed.

6. Mr. Plummer's application for increase of salary and remuneration of actual out of pocket expenses while travelling. Mr. Plummer's application for increase of Salary, &c.

Referred to Advisory Committee.

7. Mr. Caracciolo's application for increase of salary. Mr. Caracciolo's application for increase of salary.

Referred to Advisory Committee.

8. Estimate of Expenditure for 1911-12. Estimate of Expenditure for 1911-12.

Referred to Advisory Committee.

9. *Re* Auditing accounts of Board, by Mr. Campbell. *Re* auditing accounts by Mr. Campbell.

Referred to Advisory Committee.

10. Letter from Mycologist *re* visit to Suriname from 24th January to 13th February in connection with Witch Broom. Mycologist's visit to Suriname in connection with Witch Broom.

Agreed to.

11. Entomologist's Report. Entomologist's report.

On account of the late hour it was not read to the Board, but was given to the newspapers.

12. Rubber tapping Experiments. Rubber Tapping Experiments.

Postponed.

13. Rules for Cacao Prize Competition. Rules for Cacao Prize competition.

Printed and circulated. Laid on the table.

14. C.S.M.P. 371/11. Sale of horses to Government Farm. Sale of Horses to Government Farm.

Referred to Advisory Committee.

15. Mr. Caracciolo's application to have his present title of Laboratory Assistant changed to Scientific Assistant. Mr. Caracciolo's application to have his title changed to Scientific Assistant.

Referred to Advisory Committee.

After thanking the Members for their attendance His Excellency the Governor adjourned the meeting to Friday, the 24th February.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, the 24th February, 1911, at 2.15 p.m.

PRESENT:

HIS EXCELLENCY THE GOVERNOR (PRESIDENT) *in the Chair.*
THE DIRECTOR OF AGRICULTURE.
,, HON. G. T. FENWICK, C.M.G.
,, ,, S. HENDERSON.
,, ,, W. G. KAY.
,, ,, R. S. A. WARNER, K.C.
LIEUT-COL. COLLENS, V.D.
REV. DR. J. MORTON.
MR. J. D'ABADIE.
,, WM. GREIG.
,, LOUIS SEHEULT, B.SC.
,, THOS. THORNTON.
,, J. W. ARBUCKLE.
MR. J. B. RORER, MYCOLOGIST.
,, F. W. URICH, ENTOMOLOGIST.
,, P. L. GUPPY, ASST. ENTOMOLOGIST.
,, DEVENISH, SECRETARY.
Also MESSERS. W. E. BROADWAY, J. DE VERTEUIL, and A. E. COLLENS OF THE DEPARTMENT OF AGRICULTURE.

Re the late Mr. Hart.

Upon taking the Chair His Excellency the Governor said that though the late Mr. Hart formerly Superintendent of the Botanic Gardens, had not been connected with the Board, as an old Government servant he was sure that all the members would agree with him to put on record the regret and sympathy felt for his family at his death.

Minutes.

The Minutes of the meeting of the 20th January, last, having been printed and circulated, were taken as read and confirmed.

The following two letters were read:—

Messrs. Murray and de Derteuil unable to attend.

From Messrs. H. E. Murray and L. de Verteuil regretting their inability to attend the meeting.

The Financial Statement was submitted.

Financial Statement.

FINANCIAL STATEMENT.

Receipts.		
Balance on 20th January, 1911	$10,203 50	
Agriculture Tax for January	1,201 94	$11,405 44
Payments.		
Payments to 24th February, 1911		1,273 00
Balance in hand		$10,132 44
Special Votes.		
Sugar Cane Experiments (Froghopper) ($3,022) expended to 31st January		$ 911 50
Rubber Tapping Experiment ($3,000) expended to 31st January		1,489 45
Coconut Palm Destruction ($1,000) ,, ,, ,, ...		979 51
Exhibits at Local Shows ($200) ,, ,, ,, ...		130 45
Prizes for improved Cacao Cultivation ($960) expended to 31st January		40 60
River Estate Experiments ($3,360) expended to 31st January ...		800 85
Handbook ($216) expended to 31st January		nil.
Blocks and Prints for Illustrations ($200) expended to 31st Jan.		nil.
Total		$4,352 36

On the motion of Professor Carmody, seconded by the Hon. G. T. Fenwick, the following recommendations of the Advisory Committee, dated 22nd February, 1911, were adopted:— Recommendations of Advisory Committee.

1. Letter from Mycologist *re* publications of the Board of Agriculture. Letter from Mycologist *re* Publications of the Board.

   Recommended that the Hons. G. T. Fenwick, R. S. A. Warner, C. de Verteuil, Professor Carmody and Mr. Rorer be appointed as a Committee to consider the matter, and report to the Board.

2. Mr. Plummer's application for increase of salary and remuneration of actual out of pocket expenses while travelling. Mr. Plummer's application for increase of salary, &c.

   Recommended that Mr. Plummer be paid his actual out of pocket expenses for January, 1911, while employed on Coconut work.

3. Mr. Caracciolo's application for increase of salary. Mr. Caracciolo's application for increase of salary.

   Not recommended.

4. Estimate of Expenditure for the year 1911–1912. Estimate of Expenditure for 1911–12.

   Recommended, subject to the details being submitted to the Board at their next meeting.

HEAD OF EXPENDITURE.

Salaries	$10,078
Laboratory	1,000
Library	500
Office Contingencies	300
Disease prevention	800
Illustrations. etc.	700
Travelling Expenses	1,200
	$14,578

The Director suggested that Rubber Machinery be imported so that a central plant could be established in Port-of-Spain, to which planters might send their crude rubber for further treatment to fit it for the market. *Re* rubber machinery.

Recommended that the Director get further information *re* machinery, cost of installation, etc.

5. Re-Auditing Accounts of Board, by Mr. Campbell. Re-auditing accounts by Mr. Campbell.

   Recommended that a motion be made to rescind the resolution passed by the Board, at a meeting held on the 11th March, 1910, as the Accounts are audited monthly by the Audit Office.

6. C.S.M.P. 371/11, Sale of Horses to Government Farm. Sale of Horses to Government Farm.

   Recommended that it be referred to Messrs. Murray and Arbuckle.

7. Mr. Caracciolo's application to have his present title of Laboratory Assistant changed to Scientific Assistant. Mr. Caracciolo's application to have his title changed.

   Not recommended.

8. Letter from Colonial Secretary in connection with new Building for Board of Agriculture. *Re* new building for Board of Agriculture.

   Recommended that the Director of Public Works be asked if he will kindly allow one of his officers in his spare time to prepare a plan.

Mr. Hancock's application for a post on Board.

9. Letter from Mr. E. A. Hancock, through the Hon. G. T. Fenwick, applying for a post on the Board, in connection with the Plant Protection Ordinance.

Recommended that Mr. Hancock's application be put on file, in case of a new post being created.

Re-auditing accounts by Mr. Campbell.

The Rev. Dr. Morton moved, seconded by Professor Carmody, that the following resolution passed by the Board at their meeting on the 11th March, 1910, be rescinded, as the accounts are audited monthly by the Audit Office :—

"That the accounts of the Board be audited every six months and Mr. Duncan Campbell be asked to do this at a fee of two guineas per audit."

Agreed to.

Reports on cotton by Department of Agriculture.

The following papers were submitted :—

1. Progress Reports, Department of Agriculture.

Mr. Thornton spoke highly of the new cotton and gave a detailed statement as to its yield per acre.

Professor Carmody asked that seeds could be obtained free of charge, by Planters in Trinidad and Tobago.

Jerusalem pea as cover crop.

Professor Carmody reported on Jerusalem pea as a cover crop.

Department of Agriculture Reports— Rubber.

Mr. A. E. Collens reported on the Rubber Experiments carried out at Longdenville and St. Clair and gave a detailed statement as to the different amount of latex and dry rubber obtained from both places, also as to the latex collected from an old Castilloa tree in the Botanic Gardens.

Manurial experiments— *River Estate.*

Professor Carmody reported on the Manurial Experiments carried out at *River Estate* and gave a detailed statement of the yield of Cacao trees treated with pen, and other Chemical manures.

Cacao Standards— Committee reports.

2. Reports of Cacao Standards Committee.

Postponed for further information.

Letter from Mr. Reid, Tobago— for Mycologist to visit coconut disease.

3. C.S.M.P. 615/11. Letter from Mr. R. S. Reid of Tobago, respecting visit of Mycologist to Tobago, to inspect Coconut disease.

The Mycologist said that having informed the Board at the meeting of 20th January last of his intention to visit Tobago in March, he now begged to state that all arrangements had been fixed for a two weeks trip from the 28th February, 1911, with the Warden and Secretary of the Tobago Planters' Association.

Major Walker to represent Trinidad Rubber Exhibition— London.

4. Colonial Secretary's Minute Paper 4769/10. International Rubber and Allied Trades Exhibition, London.—Major E. W. Walker's offer to represent Trinidad at Exhibition in June.

Having already been dealt with by the Permanent Exhibition Committee, no further action was taken.

Mycologist's report.

5. Mycologist's Report.— The Mycologist said :—"Although I cannot attempt to-day to give a full report of my trip to Suriname I shall endeavour to bring out some of the most interesting points of my visit. I left here on the s.s. *Ascania* on January 27th and reached Paramaribo on January 30th. I met Dr. Cramer, Director of Agriculture, on the following day and he made all arrangements for my visit to various estates in the Colony. He also allowed me the use of the dark room and space for work in the Laboratory.

"During my stay I visited about twenty different estates on the Suriname, Commenowijne, Cottica and Perica Rivers and was able to see the best as well as the poorest cultivations in the Colony. During my visit I was the guest of the United Fruit Company so that I also had the opportunity of seeing the ravages of the Panama disease in bananas which together with the Witch Broom has ruined financially many of the Planters there. At present the main hope of the country is the Congo banana which is not only resistant to the disease but seems to be a good shipper as well. I had the privilege of also seeing a number of Rubber Cultivations which are coming on in a flourishing condition. I left Suriname on February 18th and arrived in Port-of-Spain on February 21st. My expenses for the whole trip were $91 58.

"Naturally the interest of my trip centres in the Witch Broom of Cacao and the question as to whether or not we have it in Trinidad. I had excellent opportunity of seeing the disease in all its stages and in all its different forms and I am very pleased to report that I have never seen anything like it in Trinidad. The various growths which have been sent in to me from various estates are absolutely different from the so-called "Krulloten" of Suriname. As I have mentioned to different planters at various times one of the most characteristic features of the true Suriname Witch Broom is the short life of the growth. The "Krulloten" never make a woody growth but die within 4 or 5 weeks and eventually fall from the tree leaving a wound which gives an opening for semi-parasitic fungi or insects. On badly affected trees every growing point and many of the cushions develop into witch brooms instead of normal shoots and flowers. I counted as many as 300 witch brooms on one tree. The hardening of the pods is another form of the disease and at times from 50 per cent. to 75 per cent. of the fruits is thus affected. The photographs which I am passing around and the specimens which I have here in alcohol will give a very good idea of the appearance of the disease. I do not think that the disease, even if it should appear at some future time in Trinidad, could ever get the foothold here that it has in Suriname or cause the same loss. From experiments in control which I saw on several Estates it is a comparatively easy matter to get rid of this disease, much easier than canker in fact. In Suriname the disease was let go until it had practically ruined many estates before any means were taken to eradicate it. I shall present a more detailed account of my trip in my annual report, but in closing I would like to thank you for allowing me to make this trip and to say that it has been a most valuable one to me, and I hope to the planters here too. I cannot adequately express my thanks to Dr. Cramer and the members of his staff who did so much for me while in Paramaribo to make my visit a profitable one or to Mr. Goodell and Mr. Whitehead of the United Fruit Company who gave me every assistance in their power."

The Secretary was directed to convey the Board's thanks and appreciation to Dr. Cramer and his staff and also the officers of the United Fruit Company for their great kindness and general assistance given Mr. Rorer during his stay in Suriname.

Dr. Cramer & United Fruit Company's Officers in Suriname to be thanked for their kindness to Mr. Rorer while there.

7. Entomologist's Report.

Entomologist's Report.

Mr. Urich said :—"Since the last meeting he was trying to establish the number of Froghoppers present in cane fields during the dry season and found that whereas he caught them by the thousands in December, during January and February the number had decreased to hundreds. As far as Chaguanas was concerned there were not many nymphs on the canes, the majority were found on traces overgrown with grass. He had completed some work in connection with the Palm Weevil which attacked both

canes and Coconut palms and would publish a paper shortly. Mr. Guppy had discovered recently a small parasitic hymenopteron on the eggs of the cacao pod hopper which may prove of some practical use, but it required studying. A paper on the Cacao Thrips had been completed and would be issued next week.

Assistant Entomologist's Report.

The Assistant Entomologist Mr. Guppy reported on a parasite found on the Pod hoppers and exhibited some sketches of them.

Mr. Brunton's application for increase of salary, &c.

8. Mr. L. A. Brunton's application for increase of salary and subsistence allowance.

Referred to Advisory Committee.

After thanking the Members for their attendance, His Excellency the Governor adjourned the meeting to Friday, the 17th March, 1911.

A. Devenish,
Secretary.

Minutes of the Board of Agriculture.

At a Meening of the Board of Agriculture held in the Council Chamber on Friday, the 17th March, 1911, at 2.15 p.m.

Present :

His Excellency the Governor (President) *in the Chair.*
The Director of Agriculture.
,, Hon. G. T. Fenwick, c.m.g.
,, ,, W. G. Kay.
,, ,, C. de Verteuil.
Lieut.-Col, J. H. Collens, v.d
Rev. Dr. J. Morton.
Mr. J. P. Bain.
,, J. D'Abadie.
,, L. de Verteuil.
,, Wm. Greig.
,, J. J. McLeod.
,, H. E. Murray.
,, J. Moodie.
,, Louis Seheult, b.sc.
,, J. W. Arbuckle.
,, J. B. Rorer, Mycologist.
,, F. W. Urich, Entomologist.
,, P. L. Guppy, Asst. Entomologist.
,, A. Devenish, Secretary.
Also Dr. L. Gough, Messrs. J. de Verteuil, and A. E. Collens.

Minutes.

The Minutes of the meeting of the 24th February last, having been printed and circulated, were taken as read and confirmed, after the words "*Longdenville and*" page 3, line 1, had been deleted.

The Financial Statement was submitted.

FINANCIAL STATEMENT.

Financial Statement.

Receipts.

Balance on 24th February, 1911	$10,132 44	
Agricultural Tax for February	1,199 00	$11,331 44

Payments.

Payments to 16th March, 1911	879 00
Balance in hand	$10,452 44

Special Votes.

		Expended to 28th Feb.	*Balance in hand.*
Sugar Cane Experiments (Froghopper)	($3,022)	...$ 941 14	$2,080 86
Rubber Tapping Experiments	(3,000)	... 1,489 45	1,510 55
Coconut Palm Destruction	(1,000)	... 990 71	9 29
Exhibits at Local Shows	(200)	... 140 83	59 17
Prizes for improved Cacao Cultivation	(960)	... 40 60	919 40
River Estate Experiments	(3,360)	... 800 85	2,559 15
Handbook	(216)	... nil.	216 00
Blocks and Prints for Illustrations	(200)	... nil.	200 00
Total	$11,958	$4,403 58	*$7,554 42

On the motion of the Director of Agriculture, the Board approved of the word "*River*" being deleted from River Estate Experiments, and the words "*Estates Experiments*" substituted.

On the motion of the Director of Agriculture seconded by the Rev. Dr. J. Morton, the following recommendation of the Advisory Committee dated 24th February, 1911, was adopted. Recommendations of Advisory Committee.

In connection a with despatch from the Secretary of State *re* space on the Royal Mail boats for bananas, &c., from Trinidad.

Recommended that for the present shipments 200 tons space will suit, subject to any later information the Director can get from the Shippers, and that the Royal Mail be asked to arrange for further space, whenever timely notice is given. Space on Royal Mail for Bananas, &c.

On the motion of the Director of Agriculture seconded by the Hon. G. T. Fenwick, the following recommendation of the Publication Committee dated 27th February, 1911. was adopted:— Recommendations of Publication Committee.

A letter from the Mycologist *re* Publications of the Board of Agriculture was read, and the Director described the methods adopted by the Department for printing and circulating the publications of the Board. Publication of the Board *re* Printing and Distributing, also *re* Papers by the Technical Officers.

(1.) It was agreed that Circulars of the Board should be headed:—

"Board of Agriculture."

(Circulated by the Department of Agriculture),

Circular No. 1,

and be numbered from 1 onwards, and date of issue added: also that they be sent out as soon as they have been printed.

(2.) That a sufficient number of copies of the illustrated plates be ordered in future by the Board for any of the Circulars that may be reproduced in the *Bulletin* of the Department of Agriculture.

(3.) It was resolved that in the opinion of this Board the Technical Officers of the Board should confine the reading and publication of papers relating to their office, to the meetings of the Board of Agriculture.

* Included in Balance on hand of $10,452 44 on 16th March, 1911.

Recommendation of Manurial Committee *re* Experiments to be carried out with manures received for "Estates" Experiments, on Sugar, Cacao, Coconuts & Cotton. Mr. J. de Verteuil appointed to take control of them at £75 per annum

On the motion of the Director of Agriculture, seconded by the Rev. Dr. J. Morton, the following recommendations of the Manurial Committee dated 8th February and 3rd March, 1911, were adopted, the Board approving of the increase of Mr. de Verteuil's honorarium to £75:—

Re 23 tons manure received for Estates Experiments to be carried out at *River Estate* or elsewhere.

(1.) Agreed that Mr. J. de Verteuil, Assistant Government Analyst, should take control of the experiments at a remuneration of £50, for the first year, his travelling expenses to be paid out of the Board's travelling vote.—(*See* below).

(2.) Agreed that experiments be made on Sugar, Cacao, and Coconuts in Trinidad, and on Coconuts and Cotton in Tobago. The following districts were selected :—

TRINIDAD.

Sugar.—Union Hall and Malgretoute at San Fernando, Esperanza at California, and Caroni at Caroni.

Cacao.—Esperanza at California, Soconusco at Santa Cruz, Montrose at Chaguanas, Sta. Marta at Tamana, Sta. Isabella at Brasso, La Compensacion at Arima, and New Grant at Princes Town.

Coconuts.—Morvant at Laventille, Nariva Cocal, and St. Marie at Cedros.

TOBAGO.

Coconuts.—King's Bay.

Cotton.—Old Grange.

A a further meeting Mr. de Verteuil explained the different experiments to be carried out on Cane, Cacao, Coconuts and Cotton, and said that h had arranged with the different planters for the following :—

Canes	— 7 plots of approximately	1 acre ea. on	4 different estates.
Cacao	—10 ,, ,,	½ ,,	7 ,, ,,
Coconuts	— 6 ,, ,,	1½ ,,	4 ,, ,,
Cotton	— 5 ,, ,,	½ ,,	1 estate in Tobago.

(1.(Agreed that one ton sulphate of ammonia, ten tons of lime, and a half ton of nitrate of soda be bought, in addition to the other manures in hand.

(2.) Agreed that experiments with the surplus manures be tried on Mr. Short's estate at Cumuto, and if possible at Mr. G. de Verteuil's estates at Talparo.

(3.) Agreed that Mr. de Verteuil's subsistence allowance be not allowed, but that his honorarium be increased from £50 to £75—on account of the large amount of work involved in these manurial experiments, and that the salary be paid from the 1st February, 1911.

The Director said that the Castilloa tree in the Emperor's valley when tapped on the 6th and 8th February, gave a yield of three pounds three ounces, and on being tapped for the second time on the 9th March last, yielded one pound twelve ounces—a few samples of rubber were exhibited.

Re Para Rubber Seed received in bad order.

The Director stated that 28 cases of Para rubber seeds had recently been received from the East but that none of the seeds were capable of germination.

Report of Prizes for improved Cacao cultivation, list of competitors.

The Director submitted a report in connection with the prizes for improved cacao cultivation and said that though Mr. Plummer had only been lately put on the prize competition he had sent in a return containing 60 competitors—Mr. Brunton 210, out of which 103 were peasant proprietors and 107 contractors.

The following recommendations of the Cacao Committee, dated 17th March, 1911, having been read, was adopted, and the Secretary was directed to inform the Secretary of the Agricultural Society of the Board's regret at being unable to carry out the experiments; but that work along lines somewhat similar to some of the experiments was already being done by the officers of the Board and the results will be published in due time.

Recommendations of Cacao Committee in connection with 10 Agricultural Experiments from Agricultural Society.

In connection with 10, agricultural experiments to be carried out by the Board's Officers.

Agreed that the Board's staff of Officers could not devote sufficient time to these experiments to give satisfactory results and that they could not get planters in the Colony to devote the necessary time to carry out the experiments in a proper way to give accurate results. Any information obtained on the subjects asked for by the Agricultural Society will be at the service of the Society.

On the motion of Lieut.-Colonel Collens, seconded by Mr. J. L. Moodie the following recommendation of the Handbook Committee, dated 17th March, 1911, was adopted:—

Recommendations of Handbook Committee.

Agreed that an extra vote of £50 be allowed for the illustrations of the *Handbook*.

The following papers were submitted:—

1. C.S.M.P. $\frac{5870}{516}$/10. Copy of draft Ordinance to amend the Board of Agriculture's Ordinance (35–1908) which will be introduced in the Legislative Council.

Copy of draft Ordinance to amend Board of Agriculture Ordinance, (35 of 1908.)

On the motion of Mr. H. E. Murray, seconded by the Hon. C. de Verteuil the following amendment to the Board of Agriculture's Ordinance No. 1908, was approved:—

Sub-section (1) of Section 4 of the Board of Agriculture Ordinance 1908, shall be read as if the words "as to the staff and as to the pay of such appointments as are paid from the funds of the Board, and as to the retention and dismissal of officers holding such appointments and" were omitted therefrom.

2. Reports of Cacao Standard's Committee.

Postponed until the Director of Agriculture receives information from Canada, in regard to standardization of various products in that Country.

Cacao Standards—Committees Reports.

3. Letter from the Manager Tabasco Plantation Company, Mexico, asking the Board for the services of their Entomologist Mr. F. W. Urich, for a period of three months from July.

Approved by the Board, subject to the consent of the Right Hon. the Secretary of State; Mr. Guppy to act as Entomologist to the Board during Mr. Urich's absence, subject to the consent of His Excellency the Governor.

Letter from Manager, Tabasco Plantation Company, Mexico, asking for the Services of Mr. Urich.

4. Mycologist's Report.

Mycologist's Report.

The Mycologist said,—Since the last meeting I have visited Tobago as planned before I went to Suriname. While there I visited a number of estates in the Southern District of the Island as well as on the Windward side as far North as King's Bay.

The Southern end of the Island is mainly given over to coconut cultivation, and the soil seems admirably suited for this purpose. The trees on the whole were in very good condition though much neglected in some places. The only disease noticed in this district was the bud rot which was present here and there. Coconuts are also planted in the Windward district especially around the Bays along the shores, and in these places are quite free from disease, though some estates are suffering slightly from lack of drainage.

Some of the trees which are planted on the hill-side are dying in some places, showing all the symptoms of the so-called root disease. It seems doubtful if this trouble is due to fungus; however, experiments are being tried to see if some satisfactory remedial measures cannot be discovered. I intend visiting Tobago again shortly and will visit other Estates on the North Coast.

The Cacao estates which I have visited in the Windward district were in a very healthy condition, as were the Rubber estates. On Thursday, March 9th, I attended a meeting of the Tobago Planters' Association, and gave an address on the common diseases of Coconut and Cacao.

5. Entomologist's Report.

Entomologist's Report.

The Entomologist said that since the last meeting the Froghopper Experiments had been going on, but that there was nothing new to report because the weather was not favourable to froghopper and there were not many in the fields. There were more in the traces overgrown with grass and he had had these cutlassed. As the froghoppers did not require all his time at present he had taken the opportunity of going on with the study of Coconut Insects which he had begun two years ago. He had come to the conclusion that the Gru-gru beetle was a coconut pest not to be disregarded and when the new Ordinance came into force, it would be one of the insects that would have to be proclaimed a pest under the Ordinance. In connection with Gru-gru beetles he had visited the Mayaro district and on two large properties he had found two apparently healthy trees attacked by Gru-gru beetles. The larvæ of the beetles had been cut out and the wound dressed with Stoprot. These trees would be kept under observation. The majority of trees attacked however had either been wounded, suffered from root disease or were growing in badly drained or unsuitable soil. With the permission of the Board he proposed visiting Tobago, as the Planters there complained of beetles in their coconuts. He had also paid a visit to the Erin district and found that arsenate of lead had been used successfully for the control of Cacao beetles.

The Director of Agriculture drew attention to the proportion of female froghoppers caught by lamp traps stated by the Government Entomologist to have been 30 per cent., whereas Dr. Gough reported that only 1½ per cent. of females were caught. The Government Entomologist stated that his first report was made on his first experiments; later work shewed that the proportion of females was much nearer Dr. Gough's figure.

After thanking the Members for their attendance, His Excellency the Governor adjourned the meeting to Friday, the 21st April, 1911.

A. Devenish,
Secretary.

Section XVI.—Rainfall.—Quarterly Returns, Jan. to Mar., 1911.

Stations.	January.	February.	March.	Total.	Total for corresponding period 1910.
North-west District.	Ins.	Ins.	Ins.	Ins.	Ins.
St. Clair—Royal Botanic Gardens ...	1·61	1·51	1·86	4·98	8·92
Port-of-Spain—Colonial Hospital ...	1·37	·68	1·84	3·89	5·54
,, Royal Gaol ...	1·52	1·79	2·10	5·41	7·76
,, Constabulary Head Quarters..	1·48	1·74	3·02	6·24	7·61
St. Ann's—Reservoir ...	1·90	1·79	2·25	5·94	9·06
Maraval— ,, ...	2·27	1·85	3·10	7·22	14·32
,, Constabulary Station ...	2·85	1·82	4·26	8·93	14·25
Diego Martin— ,, ...	1·43	3·67	2·73	7·83	14·60
,, Waterworks ...	2·36	3·25	2·01	7·62	14·76
,, River estate ...	2·00	2·98	1·92	6·90	15·25
Fort George Signal Station ...	2·59	1·82	2·55	6·96	9·84
North Post ,, ...	1·82	2·66	1·66	6·14	14·55
Carenage Constabulary Station ...	2·30	2·35	2·06	6·71	6·72
Carrera Island—Convict Depôt ...	1·75	2·77	1.71	6·23	6·70
Chacachacare Lighthouse ...	2·17	2·05	2·69	6·91	16·55
Santa Cruz—Maracas District.					
Santa Cruz—Constabulary Station ...	2·69	1·90	3·82	8·41	18·67
St. Joseph— ,, ...	1·72	1·23	·87	3·82	6·61
Maracas—Ortinola estate ...	4·37	1·85	4·12	10·34	17·88
,, Government school ...	3·74	1·41	3·66	8·81	19·77
West Central District.					
Caroni—Frederick estate ...	2·89	3·87	2·28	9·04	21·55
Chaguanas—Constabulary Station ...	1·85	2·34	·47	4·66	13·26
,, Woodford Lodge estate ...	2·43	2·18	·40	5·01	11·27
Carapichaima—Waterloo estate ...	2·15	2·01	2·36	6·52	12·14
Couva—Exchange estate ...	·68	1·42	·83	2·93	12·49
,, Brechin Castle estate ...	1·39	1·78	·93	4·10	13·48
,, Perseverance ,, ...	1·45	1·77	1·21	4·43	12·14
,, Camden ,, ...	·96	1·67	·37	3·00	10·14
,, Milton ,, ...	1·28	1·34	1·66	4·28	12·90
,, Spring ,, ...	1·05	1·72	·90	3·67	17·75
Savonetta—Esperanza estate ...	·52	1·69	1·00	3·21	11·65
San Fernando and Princes Town District.					
Claxton's Bay—Forres Park estate ...	·68	2·35	·18	4·21	10.92
Pointe-à-Pierre—Bonne Aventure estate ...	1·59	1·55	1·26	4·40	11·40
,, Concord estate ...	1·44	1·96	·91	4·31	12·05
,, Plein Palais estate ...	1·13	1·74	1·01	3·88	9·67
Naparima—Picton estate ...	·94	1·77	1·20	3·91	10·34
,, Usine St. Madeleine estate ...	1·49	1·78	2·61	5·88	15·55
,, La Fortuné estate ...	·69	1·71	·91	3·31	10·53
,, Craignish ,, ...	1·66	1·42	·65	3·73	10·31
,, Lewisville ,, ...	1·68	1·96	2·01	5·65	12·89
,, Tarouba estate ...	·90	1·72	2.21	4·83	12·93
,, Union Hall estate ...	·78	1·62	1·69	4·09	13·09
Princes Town—Cedar Hill estate ...	·74	1·72	·26	2·72	15·91
,, Williamsville estate ...	1·52	1·50	1·75	4·77	13·72
,, Constabulary Station ...	1·46	2·37	1·71	5·54	15·51
Savana Grande—New Grant estate ...	2·84	2·40	2·05	7·29	16·02
,, Malgretoute ,, ...	·91	1·45	1·93	4·29	12·52
,, Friendship and Ben Lomond estates ...	·39	·96	·58	1·93	13·05
Poole—El Rosario estate ...	3·66	3·33	2·06	9·05	21·03

RAINFALL.—*Continued.*

Stations.		January.	February.	March.	Total.	Total for corresponding period 1910.
		Ins.	Ins.	Ins.	Ins.	Ins.
Montserrat District.						
Montserrat Constabulary Station	...	1·48	2·60	·65	4·73	17·27
Brasso—La Vega estate	...	3·07	3·56	·71	7·34	20·25
Arima District.						
Arima—Torrecilla estate	...	2·53	3·14	1·02	6·69	14·23
,, Verdant Vale estate	...	3·99	5·06	1·32	10·37	18·32
,, Warden's Office	...	1·07	1·02	·38	2·47	8·79
San Rafael—Constabulary Station	...	3·13	3·67	1·28	8·08	17·83
Guanapo—Talparo estate	...	3·02	3·26	·80	7·08	23·85
South-west District.						
Oropuche—Pluck estate	...	·92	1·97	·98	3·87	9.57
,, Constabulary Station	...	1·05	1·93	·46	3·44	12·91
Siparia— ,, ,,	...	1·65	2·53	1·30	5·48	17·12
Cedros—Constabulary Station	...	3·48	1·46	4·84	9·78	17·01
Cap-de-Ville ,,	...	3·09	2·24	4·79	10·12	14·80
Guapo—Adventure estate	...	1·37	1·99	3 69	7·05	11·79
Erin—La Ressource ,,	...	1·23	4·55	3·74	9·52	12·52
Icacos—Constance ,,	...	6·05	1·90	4·05	12·00	44·65
North Coast.						
Blanchisseuse—Constabulary Station	...	7·04	4·92	5·44	17·40	36·52
Grande Rivière—Mon Plaisir estate	...	4·16	9·25	5·43	18·84	21·42
Toco—Aragua House	...	5·35	7·43	2·69	15·47	14·26
,, —Constabulary Station	...	3·80	5·99	2·16	11·95	14·34
Pointe Galera—Light House	...	·30	3·22	·33	3·85	6·28
East Coast.						
Matura—La Juanita estate	...	4·95	5·11	2·41	12·47	26·22
Manzanilla—Constabulary Station	...	4·32	4·48	1·99	10·79	27·33
Sangre Grande—Santa Estella	...	4·38	5·24	2·67	12·29	27·45
Tobago.						
Tobago—Botanic Station	...	2·63	2·73	1·56	6·92	9·07
,, Hermitage estate	...	3·22	9·15	2·96	15·36	23·01
,, Riversdale ,,	...	3·80	4·34	1·36	9·50	15·58
,, King's Bay ,,	...	2·49	6·46	2·60	11·55	19·89
,, Government Farm	...	1·18	2·59	·91	4·68	5·26

METEOROLOGICAL RESULTS FOR 1910.—OBSERVATIONS TAKEN AT THE ST. CLAIR EXPERIMENT STATION, TRINIDAD.

Month.	Barometer. Reduced Reading. 7 a.m. Bar.	Barometer. Reduced Reading. 3 p.m. Bar.	Thermometer. Dry and Wet Bulb. 7 a.m. D.	Thermometer. Dry and Wet Bulb. 7 a.m. W.	Thermometer. Dry and Wet Bulb. 3 p.m. D.	Thermometer. Dry and Wet Bulb. 3 p.m. W.	Thermometer. Mean Maximum.	Thermometer. Mean Minimum.	Thermometer. Mean Temperature Blackened Bulk in Vacuo.	Humidity.	Tension of Aqueous Vapour.	Rainfall.	Due Point 7 a.m.	Due Point 3 p.m.
1910.	In.	In.	°	°	°	°	°	°	°	°	°	In.		°
January	30·001	29·972	73·5	71·8	81·2	75·4	85·3	67·7	150·5	80	·759	2·79	70·5	71·4
February	30·044	29·995	74·2	72·5	82·1	74·4	85·2	69·4	153·5	77	·733	4·38	71·2	69·2
March	30·011	29·952	74·5	72·8	81·3	71·2	85·8	69·2	157·8	73	·690	1·75	71·5	64·3
April	30·024	29·996	76·5	73·9	82·2	74·5	80·2	69·4	157·4	74	·746	2·01	72·0	69·3
May	29·942	29·973	78·2	74·1	82·6	75·7	87·9	70·5	156·7	80	·812	2·76	72·6	73·0
June	30·020	29·954	75·9	74·4	81·6	76·3	87.8	72·0	153·3	83	·826	6·34	73·3	73·7
July	29·985	29·974	78·1	75·3	81·0	77·1	87·6	68·7	156·6	70	·704	6·40	73·3	64·3
August	29·973	29·912	76·0	74·6	81·3	76·9	87·0	71·7	157·6	86	·840	13·89	73·6	73·9
September	29·977	29·906	75·2	74·4	82·3	76·9	87·9	70·7	155·2	86	·826	8·27	73·8	73·2
October	29·985	29 888	75·3	74·3	82·1	77·3	87·3	70·8	103·2	84	·826	9·21	73·3	74·0
November	29·989	29·905	74·9	73·9	83·8	77·8	87·6	70·2	154·8	82	·826	8·49	73·2	74·0
December	29·977	29·898	72·1	71·4	83·8	75·8	81·7	68·2	153·9	80	·759	1·90	70·8	70·5
Monthly average for year	29·996	29·944	75·2	73·6	82·1	75·7	85·9	69·9	150·8	79	·778	5·68	72·4	71·9
Mean daily height of Barometer	29·970		Mean Annual Temperature				77·9		Total Rainfall		...	68·19		

Station 66·7 feet above mean sea level.

CONTENTS.

Section I.—Sugar.

LIST OF FUNGOID PARASITES OF SUGAR CANE OBSERVED IN TRINIDAD.

By Lewis Henry Gough, Ph. D.

IN publishing the following list of Trinidad fungoid parasites of the sugar cane, I make no claim to completeness, either of the species recorded, or of the literature cited. All that I have attempted to do is to give a summary of my own observations made between August, 1910, and June, 1911, coupled with the few literature references available to me here. Definite records of the Trinidad sugar cane fungoid parasites seem to be restricted to three papers by Barrett and by Went, apart from the more voluminous literature on the Root Disease.

I have in every case given the references to the literature used in making my identifications, and, as far as available, the records (for Trinidad) of other observers.

Went's paper, *Waarnemingen en opmerkingen omtrennt de Rietsuiker industrie in West Indie*, is the only one known to me at the time of writing which gives definite locality records for the West Indies for other than the three usually recognised diseases: I have quoted his records for eac species. His paper appears to have been overlooked by Keith Bancroft in his publications "Fungi causing disease of Cultivated Plants in the West Indies." (*West Indian Bulletin*, 1910, Vol. X, p. 235), and *Handbook of Fungus Diseases of West Indian Plants*, London, 1910.

I have also included the records by South, "Report on the Prevalence of some Pests and Diseases in the West Indies" (*West Indian Bulletin*, 1911, Vol. XI, p. 73) for the distribution in 1910 of a few diseases in West Indian Islands other than Trinidad.

Melanconium sacchari, Cobb. (*Trichosphaeria sacchari*, Massee). Probably not a parasite. Rind disease (?) on the stems.

Literature:

Massee, G.—"On Trichosphaeria sacchari, Massee; a fungus causing a disease of the Sugar Cane.". *Ann. Bot.*, 1893, Vol. VII, p. 515.

Butler, E. J.—"Fungus Diseases of Sugar Cane in Bengal." *Mem. Dept. Agric. in India*, Bot. Series, Vol. I, p. 14.

Went, F. A. F. C.—*Waarnemingen en Opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 38.

Keith Bancroft.—*Fungus Diseases of West Indian Plants*, London, 1910, p. 19.

Records:

St. Joseph, 5. iv. 1911, Caroni, 26. iv. 1911, Chaguanas, 8. iii. 1911, Carapichaima, 19. iv. 1911, Ste. Madeleine, 4. v. 1911

The parasitic nature of this fungus is denied by Went and Butler, and I have never found it as primary cause of disease; it seems to prefer dead canes, or such as are suffering badly from *Colletotrichum falcatum*, Went, or from *Marasmius*.

Observed by Went in Trinidad, Surinam, Demerara and Barbados.

Recorded by South (*West Indian Bulletin*, 1911, Vol. XI, p. 74) from Barbados, St. Vincent, Antigua, St. Kitts and Nevis.

Leptosphaeria sacchari, van Breda de Haan. Ring-spot of the cane leaves.

LITERATURE:

Wakker and Went.—*Die Ziekten van het Suikerriet op Java.* Leiden, 1898, p. 149.

Butler, E. J.—*Fungus diseases of Sugar Cane in Bengal*, p. 45.

Went, F. A. F. C., *Waarnemingen en Opmerkingen omtrent de Rietsuiker industrie in West Indie*, Utrecht, 1903, p. 30.

RECORDS:

St. Joseph, 21. iv. 1911, Caroni, 18. iv. 1911, Chaguanas, 8 iii. 1911, Carapichaima, 19. iv. 1911. Couva, 9. viii. 1910, Tarouba, 27. vii. 1910, Ste. Madeleine, 4. v. 1911.

Also recorded by Went for Trinidad, Surinam, Demerara and Barbados.

I have not seen spores such as are figured by Butler—Plate vi. fig. 23.

Ustilago sacchari, Rab. Smut (on the stems.)

LITERATURE:

Wakker and Went.—*Ziekten van het Zuikerriet op Java.* Leiden. 1898, p. 24.

Barrett, O. W.—"Blight in Sugar Cane."—*Proceedings Agricultural Society, Trinidad*, 1907, p. 99.

RECORDS:

Ustilago sacchari, Rab., was common at Couva in 1906 and 1907, being recorded by Barrett in 1907, and having been identified by Stockdale in 1906 (*Vide* a letter from Mr. J. R. Bovell to Mr. Arbuckle, October 16, 1906). The disease is now extremely rare or absent from the Couva district; I did not see a single case during six months' residence at Brechin Castle estate, Couva. It was not recorded by Went from the West Indies in 1903.

Schizophyllum commune, Fries. Sugar Cane Agaric (on stems and roots).

LITERATURE:

Massee—*Diseases of cultivated plants and trees.* London, 1910, p. 359.

Keith Bancroft.—*Fungus diseases of West Indian plants.* London 1910, p. 31.

Barrett, O. W.—"Cacao Pests of Trinidad."—*Proceedings Agricultural Society, Trinidad*, 1907, Vol. VII, p. 300.

RECORDS :

The record is doubtful; both Massee and Bancroft cite it as "said to be parasitic on the Sugar Cane in the West Indies." Barrett's reference is:—

"*Schizophyllum commune*, a white-capped mushroom sometimes found on old stubble and canes, may affect the cane roots in its earlier stages."

I have not observed this fungus, neither is it recorded by Went. Went however records another species of *Schizophyllum* (*S. lobatum*) from the sugar cane in Surinam (*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 32).

I have found a small *Schizophyllum* (species not yet determined) with pileus less than 1 c.m. in diameter on the leafsheaths of a cane at St. Joseph, 10. vi. 1911. The leafsheath was partly decaying; the fructifications were mostly (but not all) attached to the dead tissue.

Marasmius sacchari, Wakker. Root-disease (on stems, roots nd trash).

LITERATURE :

Wakker and Went.—*Ziekten van het Suikerriet op Java.* Leiden, 1898, p. 49.

Lewton Brain, L.—*Lectures on the diseases of the Sugar Cane*, 1904—Imperial Department of Agriculture, Pamphlet 29.

Barrett, O. W.—"Cacao Pests of Trinidad, with Notes upon Miscellaneous Crops."—*Proceedings Agricultural Society, Trinidad*, 1907, Vol. VII, p. 209.

Fulton, H. R.—"The Root Disease of Sugar Cane." Reprint in *Proceedings Agricultural Society, Trinidad*, 1907, Vol. VII, p. 195.

RECORDS :

(St. Joseph, 25. v. 1911, Couva, 25. viii. 1910, Princes Town, 6. iii. 1911. Ste. Madeleine, 4. v. 1911, (identification not complete, as fructifications have not yet been obtained).

Barrett (1907) stated that *Marasmius sacchari* was believed to be causing about 90 per cent. of the cane-blight which was reported as being very serious in Couva district in that year.

Went in 1903 recorded *Marasmius sacchari* from St. Clair Experiment Station and from the Usine Ste. Madeleine in Trinidad; also from Surinam, St. Martin and Barbados.

Recorded by South (*West Indian Bulletin*, 1911, Vol. XI, p. 73) from Barbados, St. Vincent, St. Lucia, Dominica, Montserrat, Antigua, St. Kitts and Nevis.

Diplodia cacaoicola, P. Henn. Brown rot on stems.

LITERATURE :

Butler, E. J.—*Fungus diseases of Sugar Cane in Bengal.* Calcutta, 1906, p. 28.

The fungus has been recorded by Butler and Howard as a parasite of sugar cane; although common on cacao in Trinidad, it does not appear frequently to attack sugar cane, no case of its occurrence on cane in the Colony being known to me.

Colletotrichum falcatum, Went. Red-rot, Rind-disease, on stems and occasionally on leaves.

LITERATURE:

Wakker en Went.—*Ziekten van het Suikerriet op Java*. Leiden, 1898, p. 36.

Butler, E. J.—*Fungus diseases of Sugar Cane in Bengal*. Calcutta, 1906, p. 2.

RECORDS:

Caroni, 26. iv. 1911, Chaguanas, 8. iii. 1911, Carapichaima, 19. iv. 1911, Ste. Madeleine, 4. v. 1911.

By Went (*Waarnemingen*, &c. p. 36) from Surinam, Demerara, Barbados.

By South (*West Indian Bulletin*, 1911, Vol. XI. p. 75) from Barbados and Antigua.

Cercospora vaginae, Krüger. Eye-spot disease of the leaf-sheath or Red-spot of leaf-sheath.

LITERATURE:

Wakker en Went.—*Zeikten van het Suikerriet op Java*. Leiden, 1898, p. 105.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie*. Utrecht, 1903, p. 31.

Howard, A.—*Lectures to Sugar Planters*. London, 1906, p. 170.

RECORDS:

St. Joseph, 21. iv. 1911, Caroni, 18. iv. 1911, Carapichaima, 19. iv. 1911, Couva, 22. iv. 1911, Princes Town, 17. v. 1911, Ste. Madeleine, 4. v. 1911.

By Went, 1903, from Trinidad, Surinam, Demerara, Barbados and St. Martin.

Cercospora longipes, Butler. Brown leaf-spot.

LITERATURE:

Butler, E. J.—*Fungus diseases of Sugar Cane in Bengal*. Calcutta, 1906, p. 41.

RECORDS:

St. Joseph, 21. iv. 1911, Caroni, 18. iv. 1911.

Cercospora sacchari, van Breda de Haan. Eye-spot of the leaves.

LITERATURE:

Wakker en Went.—*Zeikten van het Suikerriet op Java*. Leiden, 1898, p. 15.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie*, p. 31.

RECORDS:

St. Joseph, 21. iv. 1911.

By Went, in 1903, only from the Usine Ste. Madeleine, Trinidad.

Cercospora kopkei, Krüger. Yellow leaf-spot.

LITERATURE:

Wakker en Went.—*Ziekten van het Suikerriet op Java.* Leiden, 1898, p. 141.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 30.

RECORDS:

By Went from Trinidad, Barbados and Demerara; not observed by myself.

Thielaeviopsis ethaceticus, Went. Pineapple disease, of stems, especially of cane plants.

LITERATURE:

Wakker en Went.—*Zeikten van het Suikerriet op Java.* Leiden, 1898, p. 44.

Butler, E. J.—*Fungus disease of Sugar Cane in Bengal.* Calcutta, 1906, p. 32.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 38.

Howard, A.—*Lectures to Sugar Planters.* London, 1906, p. 155.

RECORDS:

St. Joseph, 6. iv. 1911.

Appears to be very rare in Trinidad.

By Went from Surinam, Trinidad and Barbados.

Eriosphaeria sacchari, Went. Red leaf-spot.

LITERATURE:

Wakker en Went.—*Ziekten van het Suikerriet op Java.* Leiden 1898, p. 153.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 31.

RECORDS:

St. Joseph, 21. iv. 1911, Caroni, 26. iv. 1911.

By Went from Aruba Island, in the West Indies.

Sclerotium causing "Zuur Rot." Sour rot of leaf-sheath.

LITERATURE:

Wakker en Went.—*Ziekten van het Suikerriet op Java.* Leiden, 1898, p. 121.

Went, F. A. F. C.—*Waarnemingen en opmerkingen omtrent de Rietsuiker industrie in West Indie.* Utrecht, 1903, p. 31.

RECORDS:

By Went from Trinidad.

Sclerotium causing "Rood-Rot." (Red-rot of leaf-sheath and stems).

LITERATURE:

Wakker en Went.—*De Ziekten van het Suikerriet op Java.* Leiden, 1898, p. 121.

RECORDS:

St. Joseph, 22. v. 1911, on canes D. 145, D. 4399 and D. 4805.

Section II.—Cacao.

HINTS TO PEASANT PROPRIETORS.

THE following notes have been drawn up by Mr. L. A. Brunton, Agricultural Inspector, and issued to competitors in the Cacao Prize Competition. They set out in a concise manner the chief operations, arranged under different headings, which should be carried out in each quarter of the year.

Quarterly Calendar of Work on a Cacao Plantation.

Nature of Work.	1st Quarter. January, February, March.	2nd Quarter. April, May, June.
Sanitation.	*a.* Take advantage of the dry weather to burn as much as possible of all *diseased material*. *b.* Bury all *diseased pods and shells* with white lime.	*a.* Cut all *old stumps*, &c., flush with branch or tree, and clean, drain or fill all *holes* in branches or trunk. *b.* Bury all *diseased pods and shells* with white lime. *c.* Burn *diseased material* as long as dry weather lasts.
Treatment of Disease.	PREVENTIVE. — *a.* Remove *diseased pods* as soon as possible and destroy. *b.* Look out for *cacao beetle* so as to catch and destroy it. REMEDIAL.—Attend to *diseased trees*, but make special efforts to excise *Canker* during dry weather.	PREVENTIVE. – *a.* Keep a sharp look out for, trap and destroy the *cacao beetle*. *b.* Continue removal and destruction of *diseased pods*. REMEDIAL.—Attend to *diseased trees* and continue *Canker* excision in particular until rains prevent constant work.
Tillage.	*a.* *Mulch* with grass, leaves and all available material. *b.* *Liming*, push on rapidly with this. *c.* *Draining*, *i.e.*, open ravines and big mains, that cannot be done in wet season. *d.* *Manuring* with pen manure, commence this, near end of quarter.	*a.* *Draining*, commence renewing old drains as soon as weather is favourable—Round-ridge. *b.* *Manuring*, push on rapidly so as to finish before heavy rains commence. *c.* *Forking* as soon as ground softened by rains.
Pruning.	*a.* *Clean trees* by removing moss, wild pines, dead branches, &c. *b.* *Pruning* if heavy pruning is to be done it should commence as early as possible this quarter.	*a.* *Pruning* lightly, push on rapidly to finish as soon as possible. *b.* *Cleaning*, continued and pushed on rapidly to finish early this quarter.
General.	*a.* *Reaping* in full swing. *b.* *Felling land* (if any), in preparation for planting.	*a.* *Reaping*, Rebùk and June pickings, if any. *b.* *Planting* new lands. *c.* *Supplying* cacao, shade, nurseries, &c., commences. *d.* *Cutlassing* or *Weeding* commences.

CACAO.—*Continued.*

Nature of Work.	3RD QUARTER. July, August, September.	4TH QUARTER. October, November, December.
Sanitation.	*a.* *Reduce shade* where necessary. *b.* Continue cutting *stumps, &c.*, flush and clean, drain or fill *holes.*	*a.* Continue *reduction of shade.* *b.* Continue to clean, drain and fill *holes in trees.*
Treatment of Disease.	PREVENTIVE.—Continue to trap, &c., *cacao beetle.* REMEDIAL.—Attend to *diseased trees*, look out for increase in disease with the commencement of the rains, particularly for *Root-rot*, take advantage of Petit Carême to continue *Canker* excision.	PREVENTIVE.—*a.* Remove *diseased pods* at earliest sign of disease, and destroy. REMEDIAL.—Continue to attend to *diseased trees* paying particular attention to *Root-rot.*
Tillage.	*a.* *Draining*, new, renewing, cleaning and round-ridging. *b.* *Forking*, particularly exposed places. *c.* *Manuring* take advantage of Petit Carême to continue this. *d.* *Liming*, push on with this during the Petit Carême.	*a.* *Forking* in preparation for mulching and manuring. *b.* *Mulching* with all available material as much as possible, particularly exposed places in preparation for the dry season.
Pruning.	*Dechuponée.* finish this as quickly as possible, the trees should be disturbed as little as possible this quarter.	The trees should be undisturbed this quarter.
General.	*a.* *Cutlassing and weeding*, push on rapidly in preparation for coming crop. *b.* *Building and stock*, live or dead, overhauled, repaired, or replaced in readiness for crop. *c.* *Supplying*, can continue from August.	*a.* *Supplying*, continue. *b.* *Cutlassing and weeding* must be brought to a close as early as possible. *c.* *Reaping* commences.

NOTES.

The work entered in each quarter is placed in the order of its importance for that period, and should be undertaken accordingly. In Tillage and General, when the items exceed two, usually the last items should not be commenced until the last month of the quarter.

The following items which should be attended to at all times, have, accordingly, not been placed in any quarter:—

Sanitation.—*a.* Tarring of all cuts and wounds.

b. Destruction of all diseased material by burying with white lime.

c. Liming of all cacao shell heaps.

General.—The immediate lopping, cutting up and stacking of fallen shade or other trees, the trimming and tarring of the cacao trees damaged thereby, and the supplying of minor shade, cover crops, &c.

PLANTING OF IMMORTEL FOR SHADE IN CACAO.

THE usual practice in Trinidad is to plant Immortel from stumps, that is to say from branches more or less the thickness of one's wrist. The prevalence of this practice is due to the impression that trees planted in this way grow more rapidly. This impression is in my opinion erroneous, and the practice has serious disadvantages. Trees planted from stumps can have no tap roots, and are consequently liable to be more easily blown down, and cause immense damage to the cacao.

During the last two or three years I have paid special attention to the planting of the Immortel in contracts on the Endeavour estate at Chaguanas, with the object of suppressing the method of planting from stumps. Needless to say great difficulties were experienced in getting the contractors to put in small plants, and, still more so, to plant from seed at stake. These difficulties have almost entirely disappeared, as experience has shown that when young plants, not more than twelve inches high, are used at any time between June and December, the growth of the tree is just as vigorous at the end of a year or two as when a stump has been planted. When the plants are taken out with any degree of care, no damage is done to the tap root, and it takes no more time or trouble to dig out and plant the small trees than it does to cut and plant a branch. Planting from seed at stake is in my opinion the most advantageous for the proprietor and contractor alike.

When this method is adopted the proprietor may be certain that he has a tree with a tap root which can offer greater resistance to the wind; it has cost the contractor less time to plant, and it has, if anything, within a couple of years grown to a larger size than trees planted from stumps. The only disadvantage, if it does exist, is that the Immortel seeds ripen in February and March, and if the dry season is very severe it would be advisable not to plant until May.

Contractors have often told me that Immortel trees will not grow from seed; the reason for this failure is obvious—the elementary rules of preservation have not been observed. Immortel seeds are liable to be bored by small insects, and will, undoubtedly not germinate when planted under such conditions. My experience has been that fully 95 per cent. of sound seeds planted under favourable conditions before the end of June have, not only germinated, but grown to healthy trees. I have also observed that when stored in a dry place Immortel seeds keep fairly sound until September. From October it would be preferable to use small plants, care being taken not to damage the tap-roots.

The above notes only refer to the planting of the Anauco Immortel* in young contracts; I do not think it would be a success to attempt planting seed or small plants in bearing cacao fields unless the spot was very open.

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* *Erythrina umbrosa*, generally used as a shade-tree for cacao growing on hills, but in the writer's opinion equally suitable for well drained flat lands.

I have spoken to a few planters on this subject, and the opinion generally expressed was that the Immortel tree never gave a tap root, or that, if it did, after a time it rotted. Being of a totally opposite opinion I dug round a young tree four to five years old, which I knew had grown from seed, and satisfied myself that not only the tap root was present but that it was as healthy as could be desired. I examined an older tree nine to ten years old with the same result. It might be worth recording that this older tree, besides the tap root which grew vertically into the soil, had what may be called four secondary tap roots forming angles of about 30° with the tap root.

JOSEPH DE VERTEUIL.

NOTE.

I am entirely in favour of growing Immortel from seeds as a shade for cacao and strongly against growing them from cuttings.

Besides developing a stronger root system the seedling tree attains a greater height and gives a clear space of 20 feet or more between its lower branches and the cacao below.

I have no doubt that the seeds would keep for a few months before sowing, and by that time any that were damaged by insects would clearly show outward sign of the damage.

Immortel is generally speaking a surface-rooted tree, though doubtless roots that go deeper are given off from the underside of the large lateral surface roots.

On the other hand Immortel trees grown from cuttings, besides having less power to resist wind, also require constant trimming of branches, a matter of some expense, and do not allow a clear space between their lower branches and the cacao beneath them that gives the necessary circulation of air to ensure healthy and vigorous growth of the cacao.

C. S. ROGERS,
Forest Officer.

Section III.—Coconuts.

COPRA AND COCONUT OIL.

INQUIRIES have been received by the Department respecting certain important points relating to coconut cultivation. The following answers, based on returns kindly furnished by cultivators and shippers, are published for general information:—

(1.) *Q.* How many nuts would it take to give a ton of copra?
A. 6,000 to 7,000.

(2.) *Q.* What is the approximate cost of making a ton of copra?
A. $4.50 (18s. 9d.)

(3.) *Q.* What is the usual loss in weight in shipments of copra from Trinidad to European markets?
A. 2 to 3½ per cent.

(4.) *Q.* How many gallons of oil should be got from a ton of copra?
A. 153 gallons, with 63 per cent. extraction.

(5.) *Q.* How many gallons of oil should be got from 1,000 nuts?
A. 20 to 22 gallons, but much depends on size and quality of nuts.

COCONUT CULTIVATION.

THE following is taken from Bulletin No. 11, Federated Malay States Department of Agriculture, by Mr. L. C. Brown, Inspector of Coconut Plantations, F.M.S., and is published in the hope that it will prove useful to Trinidad planters.

SELECTION OF LAND.

The rich alluvial soil, generally to be found on the low-lying lands comparatively close to the sea, is preferable. Over these low-lying lands peaty soil often exists, but provided the land has been well exposed previous to being planted, and thoroughly drained and limed, to destroy the deleterious acids which have been formed owing to stagnant water lying on or close to the surface for a long period, the trees thrive very well indeed.

PREPARATION OF THE LAND.

If the land is in forest or strong secondary growth, which is mostly the case, the trees after being felled, as well as all the wood in the clearing, must be entirely burnt off, and for the first year at least it is preferable to keep the ground free from weeds. The advantages of the land being maintained clean from the beginning are many, chief among them being the fact that the trees come to maturity at an earlier stage, the saying afterwards in maintenance and upkeep, and the great facilities afforded for ploughing and dealing effectually with pests of all kinds.

SELECTION OF SEED.

The selection of seed is a very important matter. It should be selected from well matured trees of medium age, say from 25 to 30 years, showing good yield and large-sized roundish nuts either red, brown, or green, and not oblong nuts. Nuts chosen for seed must be fully ripe, and a careful examination made to see that they are not damaged in any way. It is an advantage, too, I consider, not to plant the seeds for a month or so after they have been picked so that the outer skin may get thoroughly dry and the husk be allowed to harden.

NURSERIES.

The beds prepared for the nurseries should be of rich soil and slightly raised so as to allow good drainage. The nuts are placed in rows about one foot apart, and should for a short time be partially shaded. A thin layer of sand on the bed is of advantage, as it prevents the ground from getting damp, which tends to cause the roots to rot.

In planting out the seed nuts in the nurseries prepared for them, they should be buried to half their depth and placed in a slightly oblique position, with the acute end of the nut downwards.

There is another method in which I have seen the nuts germinate quite satisfactorily, and that is by tying them in pairs by a portion of the outside husk and hanging them on long bamboos supported at a height of about 6 feet by a tree or post in the ground and so placed that the seedlings are protected from too much exposure.

It will be found that the leaves and roots soon protrude, and the young plants are ready to be removed for planting out in the clearing at the customary period.

CATCH CROPS.

When the soil is alluvial and sufficiently above sea level, I would strongly recommend coffee as a catch crop, either Liberian or Robusta, preferably the latter, being planted at the same time as the coconuts.

Another system, provided the soil is suitable and there is a good demand for the produce, is to put in fruit trees, planted quin-cunx, at the same time as the coconuts.

Para or rambong* rubber trees should on no account be interplanted with coconuts as they cannot possibly thrive well together.

PLANTING.

The trees should be planted 30 feet by 30 feet, which gives about 48 trees to the acre; this distance will allow for interplanting coffee and fruit trees.

After the ground is thoroughly cleaned, the pits for planting out the young plants should be dug. The larger the pits are the better, but 2 feet cube is generally considered sufficient. All the soil removed from the pits should be replaced by good surface soil to within six inches of the top. When this work is finished, the young plants, which should be from 5 to 7 months old before being removed from the nursery, may now be placed in these holes, leaving the nut of the seedling about 6 inches to a foot below the surface and just slightly exposed. When the plant has come well away, say with about a dozen well grown leaves on it, the holes should be filled to the top with good soil.

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* *Ficus elastica*, Assam rubber.

DRAINAGE.

Where the land is undulating in even slopes little or no drainage is required, but on the low flat alluvial soil drainage is of considerable importance, and it is always advisable in this case to have drains dug all round the proposed clearing before felling the jungle or secondary growth. This is especially the case where the soil is of at all a peaty nature, and here, after the clearing is burnt off, it is of advantage to keep the land exposed for as long as possible, say at least six months, during which time attention should be paid to further drainage, if necessary. The coconut tree probably is less affected by sour land than most tropical plants. At the same time, stagnant water must sooner or later have a very deteriorating effect on the trees.

MAINTENANCE.

The land is always better if kept clean weeded, but after the trees are in bearing, unless the catch crop is coffee, grass may be allowed to remain, even where there are fruit trees. The coconut trees themselves, however, should be circled and dug round if possible every three months, and where coconuts only are planted, ploughing over the whole land periodically to a depth of nine inches will be found to be very beneficial.

As the trees advance in age, the radius of the circle dug up should be increased—for one-year-old trees 2 to 3 feet from the stem of the tree will be found sufficient; for two-year-old trees the radius should be increased to 4 feet and so on; the circle dealt with in this way when the tree reaches maturity and is in full bearing is about 8 feet from the stem.

The above remarks refer more especially to the stiffer land, but where the soil is loamy and rich this digging up and ploughing may perhaps not be found necessary, until the trees are more advanced in age.

Provided all the leaves of the trees have got beyond their reach, cattle and buffaloes may with advantage be allowed to graze over the plantation.

The dead leaves as they fall or are picked off should be heaped up in rows, not too high, between the trees and burnt off as opportunity offers. It is of some advantage to lay clods of earth over these heaps before burning, as the burnt earth so obtained may be applied to the trees at the time the circle round them is being dug up.

The trunks of young trees should not be cut to make steps for climbing, although it may perhaps do less harm to the older trees.

MANURING THE TREE.

On rich alluvial soil, provided the trees are properly cultivated, they will continue to bear fairly average crops for a considerable number of years. The natives never manure the trees in their kampongs, but the fact of trees being near habitations no doubt has a great deal to do with the trees thriving so well in their holdings. It is certainly an advantage for the trees to be manured periodically in cases where the crops show any sign of decreasing, and, where the soil is at all peaty, lime should be applied abundantly to the trees from the start. Inland and on the stiffer soils, I consider manuring the trees when they have reached maturity most important.

The system of manuring which I would recommend is as follows:—

A trench is dug half way round the tree, about nine inches in width and say 1 foot in depth, close to the extremity of the roots. This trench may be

left open for a short time, then the manure filled in and the soil that has been excavated replaced. The following year, the other half of the tree is treated in a similar manner.

As regards manures the most easily obtainable is generally cow dung, and about ¼ of a cart load to ¾ or 1 gantang of salt will be found an excellent mixture, while advantage can be taken of the burnt earth previously alluded to, by having this turned in at the same time. Fish manure, when it can be obtained in good quantity and at a reasonable cost, is strongly to be recommended, and, in my opinion, is the best manure for coconut trees.

Bone dust is also good, but owing to its high price the use of it is now prohibitive. Guano and Tye klawar, which are both very costly, are too strong; no doubt the crops are often very heavy soon after these are first applied, but this is only for a comparatively short period, and on subsequent occasions increasing amounts of these fertilisers must be used to give good results.

COPRA.

For the manufacture of copra, unripe nuts are useless, and great care should be taken to pick only fully ripe ones. One coolie ought to husk 500 nuts a day. A better return is obtained if the nuts are stored for a month or so before being opened, and it lessens the cost of manufacture as the kernel is more easily extracted from the shell.

The nuts after being split open should not be laid on ground which is moist and muddy, as in this way grit and dirt get into the kernel, and this tends to lower the quality of the copra.

While the collections are comparatively small and the nuts difficult to sell locally a very cheap drying kiln for the treatment of copra may be constructed in the following manner :—

A table 12 feet square and 4 feet in height with a platform made of nebongs must first be erected.

This table is then covered round with a mud wall 1½ feet in width and 6 feet high, leaving a small open space in this shape ⌓ on one side to allow of the fuel, which is generally the coconut shell, being placed beneath the platform. For sun-drying purposes, in connection with the kiln, a drying table is required, say 50 feet long by 6 feet from the ground.

The wood work for the above structures may be entirely made from the Nebong palm,* which is very abundant in the forest lands throughout the States and consequently not costly.

EXTRACTION OF TODDY OR SUGAR FROM THE TREE.

The spathe or blossom of the tree may also be used for extracting the juice from which is prepared toddy or sugar, by a process very easily acquired from the natives, and some are of opinion that it brings on the young trees more quickly than would otherwise be the case.

This treatment should not be continued too long—say one year—after which the nuts should be allowed to mature and collected in the usual way.

A considerable period should then be allowed to elapse before again treating or tapping the young shoot of the tree for this purpose.

* *Oncosperma filamentosum.*

COLLECTING THE PRODUCE.

Climbing the trees for the collection of the fruit is in my opinion the best method. When the plantation is in full bearing one coolie can collect 400 nuts a day.

The practice of using a knife attached to a long pole for cutting down the nuts is not to be recommended; in the bunches so collected several insufficiently ripe nuts will be found. At the time of collecting the nuts, all the dead spathes and leaves should be removed, and thorough search made to see that no beetles are in the trees. The coir substance which clings to the tree, and in which the leaves and spathes form themselves, should always be left, as it protects the cabbage and retains moisture.

It occasionally happens that a tree, although it has to all appearances matured, gives no sign of fruit or blossom. In such circumstances, a heap of leaves and rubbish should be burnt close to the trunk of the tree. This often has the desired effect of bringing the tree into bearing, but should only be resorted to in such a case as I have instanced, otherwise it is harmful.

RETURNS AND PRICES.

On rich alluvial soil trees have been known to give fruit in their 3rd and 4th years, but on the whole, an average of say 10 nuts per tree in the 6th year, 30 nuts per tree in the 7th year, and 50 nuts per tree afterwards is all that can be expected, though with good cultivation the crops are often in excess of this estimate. Inland, the trees do not come on so quickly; in fact, it is usually not till after the 8th year that the trees come into bearing.

An average return of copra, under ordinary circumstances, is 4·3 pikuls per 1,000 nuts, but this percentage is often greatly exceeded where proper attention is given to its manufacture.*

The average price for coconut for the past five years, *i.e.*, 1905 to 1909, has been a little over $30 per 1,000 and that of copra $8.65 per pikul.

ESTIMATES FOR OPENING UP LAND.

I attach for general information an approximate estimate for opening up 500 acres in the Coast District, for which I am indebted to Mr. Munro, of Jugra, a practical and experienced coconut planter and an excellent authority on the subject.

It will be noticed from the estimate given that the expenditure of the estate up to the 6th year works out at something under $165 per acre, and after such time the plantation becomes self-supporting. If, however, a catch crop of coffee, as has already been recommended, is planted up at the same time as the coconuts, the revenue derived from the former product lessens the actual outlay very considerably.

The labour conditions, of course, differ slightly in the various districts of the States, but the estimate should prove of great assistance to the would-be planter as a reliable guide of the expenditure and income to be anticipated from an acre cultivated with coconuts.

Where there is European supervision at least 500 acres should be planted up. With 2,000 acres or over, in full bearing, the crops will be sufficient to feed an oil mill, and in connection therewith a Coir factory might be erected for the manufacture of the fibre into rope.

*This is equivalent approximately to 1 ton of copra from 4,000 nuts; a much higher yield than that given on p. 186; but in Trinidad and Tobago only small nuts are made into copra, the large ones being exported whole.—(Ed.)

ESTIMATE FOR OPENING UP AND BRINGING INTO BEARING 500 ACRES OF COCONUTS IN THE COAST DISTRICT.

1st Year's Expenditure.

Premium $1,500 (= £175), Quit Rent $500 (= £58 6 8), Survey Fees $500 (= (£58 6 8)	$ 2,500 (= £ 291 13 4)
Felling $6,000 (= £700), Draining $6,000 (= £700), Seed $2,750 (= £320 16 8)	14,750 (= £1,720 16 8)
Fencing $1,500 (= £175), Lining and Planting $1,000 (= £116 13 4)	2,500 (= £ 291 13 4)
Coolie Lines $500 (= £58 6 8), Bungalow $1,200 (= £140)	1,700 (= £ 198 6 8)
Tools $250 (= £29 3 4), Stationery $100 (= £11 13 4), Medical $1,500 (= £175)	1,850 (= £ 215 16 8)
Weeding 1st 6 months @ $1.50 (= 3/6) per acre ..	4,500 (= £ 525 0 0)
Contingencies	1,000 (= £ 116 13 4)
Superintendence	3,600 (= £ 420 0 0)
	$32,400 (= £3,780 0 0)

2nd Year's Expenditure.

Rent $500 (= £58 6 8), Weeding $6,000 (= £700), Superintendence $3,600 (= £420), Medical and Contingencies $2,000 (= £233 6 8) ... ...$12,100 (= £1,411 13 4)

3rd Year's Expenditure.

Do. do. do. ...$12,100 (= £1,411 13 4)

4th Year's Expenditure.

Do. Weeding $3,600 (60c.) (= £420) do. ...$ 9,700 (= £1,131 13 4)

5th Year's Expenditure.

Do. $3,000 (50c.) (= £350) do. .. $ 9,100 (= £1,061 13 4)

6th Year's Expenditure.

Rent $1,000 (=£116 13 4), Weeding $3,000 (= £350), Superintendence $3,600 (= £420), Picking $300 (= £35), Curing $1,130 (= £131 16 8), Transport $1,130 (= £131 16 8) ... .$10,160 (= £1,185 6 8)

7th Year's Expenditure.

Do. do. do. ...$14,800 (= £1,726 13 4)

8th Year's Expenditure.

Do. do. do. ...$17,300 (= £2,018 6 8)

9th Year's Expenditure.

Do. do. do. ...$19,400 (= £2,263 6 8)

Returns.

6th Year 10 nuts per tree = 1,130 pikuls of copra at $8.00 (220 nuts to pikul)	$ 9,040 (= £1,054 13 4)
7th Year 3,400 pikuls of copra at $8.00 (30 nuts per tree)	27,200 (= £3,173 6 8)
8th Year 4,500 pikuls of copra at $8.00 (40 nuts per tree)	36,000 (= £4,200 0 0)
9th Year 5,650 pikuls of copra at $8.00 (50 nuts per tree)	45,200 (= £5,273 6 8)

Note.—The Straits dollar has a fixed value of 2s. 4d. A pikul equals 133⅓ lb.

Section VI.—Rubber.

INTERNATIONAL RUBBER AND ALLIED TRADES EXHIBITION, 1911.

I.—Report of the Official Delegate.

1. As directed by Your Excellency, I represented the Colony of Trinidad and Tobago as official delegate at the above Exhibition which was held in the Agricultural Hall, Islington, from June 24 to July 14. This is the first Rubber Exhibition in which the West Indian Colonies have been represented; and British Guiana, Jamaica and Dominica, as well as Trinidad occupied separate Courts at this Exhibition. Mr. Stockdale, Assistant Director of Agriculture, was sent as special representative for British Guiana, Jamaica and Dominica were represented by Mr. Algernon E. Aspinall, Secretary of the West India Committee. The latter undertook also on behalf of the Permanent Exhibition Committee the business arrangements connected with the Trinidad Court, and to this I shall refer later. Our Court was in the main hall of the building, and the space allotted to us was much larger than that of any of the above three Colonies represented whose exhibits were shown in the adjacent annex (the King George's Hall). Partly owing to our advantages as regard position and space, but mainly to the number and variety of our exhibits, Trinidad took the leading position among the West Indian Colonies at this Exhibition.

2. The rubber exhibits from Trinidad and Tobago were shown separately; and a further sub-division was made into estates, and the different kinds of rubber from each indicated by conspicuous labels. The botanical specimens and enlarged photographs adorned the sides, and added greatly to the attractive appearance of the Court.

3. The centrifugal machine made by Mr. H. S. Smith for his preliminary experimental work was at first shown in the Court, but was afterwards removed to the adjacent annex for demonstrations in the separation of rubber from the latices of Castilloa, Hevea and Funtumia which were very kindly supplied by other exhibitors.

4. Pamphlets containing information about the Colony were placed in convenient positions, and although a large number had been printed the supply barely proved sufficient for the whole period of the Exhibition.

5. I attended daily at the Court for the purpose of giving information on local agricultural matters, and dealt with numerous inquiries which were not confined solely to rubber.

6. The exhibits of Castilloa rubber from Tobago attracted the attention of many visitors. The sheets prepared by Mr. Smith's centrifugal machine were so superior in appearance to Castilloa as ordinarily marketed that some of the visitors were disinclined to believe that they were Castilloa rubber.

7. Of the quality of our exhibits it is unnecessary for me to write, since valuable independent testimony is contained in the reports by Messrs. Lewis and Peat (the well known rubber brokers), and by Mr. Kelway Bamber, (the Ceylon expert). These reports were obtained by Mr. Aspinall, and I am permitted to include them in this report. [pp. 198–204.]

8. The exhibit of Para rubber sent by Mr. Boos was sufficiently large to attract attention to the possibilities of the production of this kind of rubber in Trinidad.

9. The demonstrations given by Mr. Smith on the separation of rubber by a new centrifugal method added considerably to the interest taken in Trinidad and Tobago as rubber-producing centres making use of skilled appliances. At first it was difficult to convince some critics that there could be anything new in centrifugal methods of preparation, but the demonstrations soon removed any doubts that existed. The preparation within ten minutes of a sheet of dry rubber from the latex of Hevea, Funtumia or Castilloa trees came as a surprise to many who had seen only the partial separation methods of the centrifugal machines in use previously. Owing to the limited supplies of latex available it was not possible to demonstrate to the full the advantages which this machine undoubtedly possesses ; and it was entirely owing to the generosity of other exhibitors in supplying latex that these demonstrations could be given. In this connection special mention must be made of Messrs. David Bridge and Co. who supplied Para latex which was intended for use in machines of their own manufacture.

10. At one of the demonstrations Sir Henry Blake was present, and among others who attended them were several home and foreign experts in rubber separation methods.

11. Representatives of the Rubber Growers Association very kindly accepted an invitation to a demonstration specially arranged for them. Among those present were :—

> Mr. A. Bethune (President), Mr. R. K. Mayor (Vice-President), Mr. John McEwan, Mr. T. G. Hayes and Mr. C. Taylor (Secretary). Dr. Stevens was also present. Both Castilloa and Para rubber were separated, and within the usual period of ten minutes.

12. The commercial machine manufactured by the firm of Messrs. John Gordon & Co., and shown on their stand, possesses several mechanical advantages tending towards simplicity of working. Demonstrations with this large machine could not be given as there was not sufficient latex available for so large a machine.

13. In a paper read at one of the Conference Meetings Mr. Smith described the working of the machine and an animated discussion followed. The machine, the demonstrations, and the descriptions given by Mr. Smith added greatly to the interest taken in our exhibits by those who visited the Exhibition to study seriously any new points connected with rubber.

14. The sample of Funtumia rubber prepared at one of these demonstrations was so vastly superior in colour and quality to the ordinary commercial article that no one who had seen it would be likely to advise the separation of Funtumia rubber in any other way.

15. Conference Meetings were held during the Exhibition at which several papers relating to rubber were read and discussed. I attended several of these meetings, and would have attended more if sufficient notification had been given of the order in which the papers would be read. This apparently could not be done.

16. The question of producing a rubber of standard quality was discussed more than once at these Conference meetings. Manufacturers object to variability as this hampers greatly their operations, and are evidently prepared at present to pay for uniformity until standard tests for rubber have been agreed upon. This attitude is a very reasonable one, and on the whole is beneficial to planters who will be able to sell any grade or kind of rubber so long as it comes within certain limits of uniformity peculiar to that grade or kind. Manufacturers were invited to give planters more assistance and advice as to the tests applied by purchasers; but the requirements of manufacturing operations are evidently so varied that no general rules for guidance are at present available.

17. Trinidad received comparatively short press notices in the newspapers; but this can easily be explained verbally.

18. Mr. Smith of Tobago was one of the competitors for the valuable trophy offered by the *India Rubber World* of New York and his method of tapping was commended by the Judges. Their report will be published later. The Judges (of whom I was one) were unable to award this prize owing to the conditions attached to the competition. Had the conditions included the preparation of rubber from the latex the trophy would probably have come to Tobago.

19. The West India Committee offered two prizes for competition among the West Indian Exhibitors and two others were offered through the Committee; the Judges awarded two of these to Trinidad.

(*a*.) Silver Cup offered by Messrs. Booker Bros. McConnell & Co., Limited, for the best Exhibit by a West Indian Botanic Department and

(*b*.) Silver Cup offered by Mr. W. Middleton Campbell for the best West Indian Comprehensive Exhibit.

20. Mr. Aspinall has contributed largely to the success of the Trinidad Court at this Exhibition. He secured a most advantageous position with sufficient space to make a very neat and effective display of the numerous exhibits; he gave personal attention to all the business details and provided a most valuable attendant who took the keenest interest in describing the exhibits to the large number of visitors to the Court. He arranged for the special reports of Messrs. Lewis and Peat and of Mr. Kelway Bamber on the quality of our rubber, and has thus materially assisted the further development of this industry in our Colony. We now know that Castilloa rubber when properly prepared would rank very close to Hevea, and that our methods of preparation have produced the exhibits of Castilloa rubber to which the opinions of the above experts refer.

21. The exhibits prepared by the Department of Agriculture were, at the close of the Exhibition, handed over to the Imperial Institute for permanent exhibition there as previously arranged. The album of photographs representing the rubber and other industries of the Colony will be permanently exhibited at the West India Committee Rooms.

22. The official delegates from British Colonies were more numerous at this Exhibition than is usually the case, and all were officers of the local Departments of Agriculture. I was glad to see this, because I have for many years been convinced that the presence of these officers at exhibitions would greatly advance the progress of agriculture in our Colonies. My own experience at this Exhibition is that there are many who are taking a wider and deeper interest in tropical agriculture for which they require more specific information than can be supplied by the ordinary hired attendants (however good they may be) at these exhibitions; and as a result it is now likely that in addition to the benefits which the rubber industry may derive from the Exhibition, one or two new industries may be started in the Colony and a wider demand created for industries already existing. In the special issue of *The Times* it is stated that—

> "A remarkable feature is the extent to which the support of the Governments of rubber-producing countries has been accorded to this Exhibition, and the large expenditure which has been undertaken by these Governments in order that the conditions surrounding cultivation and preparation of the product shall be worthily presented."

British Colonies in Asia, Africa and the West Indies can, I am glad to report, be included in the above; and of peculiar interest was the fact that the pioneer of this industry, so far as British Colonies are concerned, is still living and was entertained at dinner and presented with a testimonial by the Rubber Growers Association, which has not forgotten how much it owes to the few thousand plants raised from the seeds collected by Mr. Wickham and shipped by him under circumstances which may now be regarded as singularly fortunate.

(Sgd.) P. CARMODY, F.I.C., F.C.S.

August 14, 1911.

II.—Exhibits sent by the Department of Agriculture.

HEVEA (PARA) RUBBER.

FROM BOTANIC STATION.

No. 1.—Blocked Scrap from 12 years old trees.

„ 2.—Loose Scrap from 12 years old trees.

„ 3.—Blocked Scrap from 30 years old trees.

„ 4.—Loose Scrap from 30 years old trees.

„ 5.—Blocked Trimmings from 12 years old trees.

„ 6.—Crêpe (Blocked) from 12 years old trees.

„ 7.—Biscuit—Coagulated in sulphuric acid 5 per cent. (10 drops for each 100 c.c. of latex), creamed in 24 hours and rolled, smoked to dryness. Trees 30 years old.

„ 8.—Biscuit—Coagulated with lime juice, 10 drops to 100 c.c. of latex, creamed in 24 hours and rolled, unsmoked. Trees 12 years old.

„ 9.—Biscuit—Coagulated with pyroligneous acid. Unsmoked, 12 years old trees.

„ 10.—Biscuit—Coagulated with sulphuric acid 5 per cent. (10 drops for each 100 c.c. of latex) creamed in 24 hours and rolled. Smoked to dryness. Trees 12 years old.

„ 11.—Block—Coagulated with pyroligneous acid process, pressed into block immediately, unsmoked. 12 years old trees.

„ 12.—Block—Latex creosoted and coagulated with acetic acid, pressed into blocks immediately, unsmoked. 12 years old trees.

„ 13.—Block—Coagulated acetic acid, blocked immediately, unsmoked. Trees 12 years old.

„ 14.—Block—Latex preserved with formalin, and coagulated by acetic acid method, unsmoked. 12 years old trees.

„ 15.—Block—Latex preserved with formalin, and coagulated by sulphuric acid method, unsmoked. 12 years old trees.

„ 16.—Block—Coagulated by sulphuric acid process (1 c.c. of 5 per cent. sulphuric acid added to each 100 c.c. of latex). Blocked immediately, unsmoked. 12 years old trees.

„ 17.—Block—Latex creosoted, coagulated with sulphuric acid and blocked immediately, unsmoked.

CASTILLOA (CENTRAL AMERICAN) RUBBER.

FROM BOTANIC STATION.

No. 18.—Ball—Scrap. Trees 30 years old.

„ 19.—Sheet—Prepared by creaming and drying on wooden frame, unsmoked. Trees 30 years old.

„ 20.—Sheet, 1 lb.—Creamed three times, dried on cloth frames and smoked. Trees 14 years old.

„ 21.—Biscuit—Prepared by boiling process. 30 years old trees.

„ 22.—Block—Prepared by boiling, then blocked. 12 years old trees.

„ 23.—Block—Creamed only. 6 years old trees.

FUNTUMIA RUBBER.

From Botanic Station.

No. 24.—Trimmings—Boiled with formic acid lightly smoked. Trees 12 years old.

,, 25.—Block—Boiled with acetic acid, slightly smoked. Trees 12 years old.

CEARA RUBBER.

From Oropuna Estate.

No. 27.—Sheet—Natural coagulation. 10 years old trees.

,, 28.—Ball—Scrap. 10 years old trees.

LANDOLPHIA RUBBER.

From Botanic Station.

No. 26.—Ball—Scrap. Wound off. 8–10 years old trees.

FICUS RUBBER (FICUS ELASTICA).

From Botanic Station.

No. 48.—Biscuit.

"BASTARD" HEVEA RUBBER.

From Botanic Station.

No. 29.—Rubber from *Hevea confusa.*

HERBARIUM SPECIMENS—FRUITS, SEEDS, &c.

From Botanic Station.

No. 51.—*Hevea brasiliensis,* Muell. & Arg. Herbarium specimens.
,, 52.—*Castilloa elastica,* Cerv. Herbarium specimens.
,, 53.—*Funtumia elastica,* Stapf. ,, ,,
,, 54.—*Funtumia africana,* Stapf. ,, ,,
,, 55.—*Ficus Vogelii,* Miq. ,, ,,
,, 56.—*Ficus elastica,* Roxb. ,, ,,
,, 57.—*Landolphia* sp. ,, ,,
,, 58.—*Manihot Glaziovii,* Muell & Arg. Herbarium specimens.
,, 59.—*Mimusops globosa,* Gaertn. Herbarium specimens.
,, 60.—*Hevea confusa,* Hemsl. ,, ,,
,, 61.—Seeds of *Funtumia elastica.*
,, 62.—Seeds of *Funtumia africana.*
,, 63.—Fruit of *Funtumia elastica.*
,, 64.—Fruit of *Funtumia elastica* preserved in formalin.
,, 65.—Fruit of *Castilloa elastica* preserved in formalin.
,, 66.—Fruit of *Landolphia* sp. preserved in formalin.
,, 67.—Fruit of *Landolphia* sp.
,, 68.—Fruit of *Manihot Glaziovii.*
,, 69.—Seeds of *Landolphia* sp.
,, 70.—Seeds of *Hevea confusa.*
,, 71.—Seeds of *Castilloa elastica.*
,, 50.—Castilloa latex.
,, 92.—Seeds of *Funtumia elastica* (cleaned).
,, 94.—Seeds of *Manihot Glaziovii.*

LIVING SEEDLINGS OF RUBBER PRODUCING PLANTS.

FROM BOTANIC STATION.

No. 72.—Plants of *Castilloa elastica.*
,, 73.—Plants of *Funtumia elastica.*
,, 74.—Plants of *Hevea brasiliensis.*
,, 75.—Plants of *Hevea* sp. from Santa Cruz.
,, 76.—Plants of *Landolphia* sp.
,, 77.—Plants of *Mimusops globosa.*

MISCELLANEOUS.

No. 93.—Tool for tapping Castilloa.

III.—Reports on West Indian Rubber.

Messrs. Lewis and Peat, of Mincing Lane, were kind enough to examine critically the various exhibits in the West Indian section of the recent International Rubber Exhibition, and have submitted the following commercial report regarding them :—

The West Indies were represented at the International Rubber Exhibition by Trinidad and Tobago, British Guiana, Dominica and Jamaica. About eighteen or twenty different estates sent samples, and the quality and variety of sorts exhibited showed a great improvement on those displayed at the last show held at Olympia three years ago.

HEVEA.—Practically all the samples were good, and some compared very favourably with those from Malaya and Ceylon. The quality of the rubber without exception was satisfactory, but a little more experience must be gained, and a little more attention paid to the various stages of the preparation, especially the washing and drying. Many exhibits were spoilt by being insufficiently dry, and others by being too resinous, many showing small particles of dirt and bark. The smoked biscuits from the Trinidad Botanic Gardens deserved special mention.

CASTILLOA.—Taken all round, the exhibits of these species were excellent, and the rubber prepared by Mr. H. S. Smith's new machine was as good as any yet produced from this tree. The two best samples shown were from Major Walker's estate, Easterfield, and Mr. Smith's, Caledonia estate, Tobago. These sheets showed what can be done with Castilloa latex, and we should think that this rubber would rank very close to Hevea if sent to the market as well prepared as these two exhibits. They were better than anything we have seen, either from Mexico or anywhere else. The CEARA samples were good, but nearly all showed too much resin, but this might be entirely due to the tree being very young, and to the insufficient washing after coagulation and before drying.

The small samples of LANDOLPHIA, FUNTUMIA, and FICUS shown by the Trinidad Department of Agriculture, indicated that all three of these species give a very marketable latex; but we doubt whether their cultivation where Hevea, Castilloa, or Ceara will grow with such good results as shown by the other exhibits, is advisable.

Altogether the collection was most satisfactory, and although the West Indies are perhaps a few years behind the big plantation centres of Ceylon and Malaya, they are certainly coming along very fast, and in a few years will be able to compete. As to Castilloa curing, we think that Mr. H. S. Smith and his colleagues are teaching the rest of the world how to do it, and if they can be sure of a good yield they will bring the cultivation of this species to a very high position in the rubber planting world.

Naturally, until the production can be increased so that regular supplies can be relied upon, it is very difficult to obtain fair values, and with such small and irregular parcels, both as regards quantity and quality, prices from time to time are most erratic and cannot be fairly quoted as the intrinsic value of any one of them against either Wild Para or Plantation Para cultivated with success in the Middle East.

Trinidad.

La Victoria Estate (G. G. Brown)—33. Good strong well-prepared sheet, in good condition but a little rough. Quite a good exhibit.

Stearridonum Estate (Carr Bros.)—89. Small uncured biscuit; would be all right if rolled thinner and dried right through. 90. Ordinary ball scrap.

Ellensville Estate (N. F. Graham)—44. Small uncured strip, clean and strong. Would be a good sample if dried right through. 46. Small, clean, well-prepared biscuits; only one properly dried, the other three virgin, uncured; should be kept until quite dry right through, and transparent. These biscuits are rather too opaque and resinous when stretched; probably insufficiently washed.

Verdant Vale Estate (Trinidad Cacao and Coffee Co.) - 86. Four small sheets; two are good, well-prepared, probably lightly smoked, but too thin. Two are too thick and cut virgin; should be a little thinner and dried right through. The biscuits have been put on canvas or on the ground, and on one side small particles of dust, dirt, and hair are adhering. This should be avoided and the rubber kept perfectly clean. 87. One small Hevea biscuit, fair quality, well prepared and in good condition, but a little rough in appearance.

Rio Claro Estate (The Poole Syndicate).—47a. Fine, well-prepared sheets in good condition and strong, but too thick and opaque, evidently not thoroughly dried; would recommend smoking or otherwise drying until quite transparent. Otherwise an excellent exhibit. 47b. Imperfectly dried biscuits; otherwise good quality and well-prepared.

Monte Cristo Estate (H. Monceaux).—32. Castilloa ball scrap. From external appearance, good quality, strong and fairly clean; not an up-to-date preparation. Would be better washed, dried and shipped free after picking out all bark and heated pieces.

Botanic Station (Department of Agriculture).—18. Small ball scrap; fair average quality. 19/20. Sheets and biscuits fairly well prepared, and mostly in good condition; one or two show signs of heat and stickiness, and some are imperfectly dried.

Nonpareil Estate (E. A. Robinson).—42. Fine well prepared, smoked Hevea biscuits, in excellent condition. Although these biscuits show little room for improvement, we would recommend making larger sheets and rather thicker, which would not take up so much room and would be easier to handle.

Botanic Gardens (Department of Agriculture).—1. Blocked Hevea scrap, slightly sticky, good quality, but better free after all heated and barky pieces have been sorted out. 2. Small scrappy balls; much better form than No. 1. 3. Similar to No. 1, but rather better quality. 4. Similar to No. 2. 5. Pressed cuttings; one a very fine sample of its kind, and would sell a little below the fine sheets and biscuits. The other rough and scrappy. 6. Similar to No. 5, but not dried. 7. Fine smoked Hevea biscuits, good colour and thickness and in excellent condition, with the exception of one very thick biscuit, which is not quite dried through. About the best Hevea sample on the stand. 8, 9, 10. Fair average quality unsmoked Hevea biscuits. 11. Good tough Hevea sheet; apparently excellent quality. 12. Similar to above. 13. Similar to above, but very pale in colour. 14. Similar to above; not properly dried 15. Small pale biscuit; good quality. 16, 17. Small pale sheet of fair quality. 24. Various pieces of Funtumia rubber all show good strong quality. 26. Good small Landolphia ball, clean and in good condition. 27. Dark discoloured biscuit and very resinous. 28. Fair Ceara ball in good condition. 29. Small clear amber lump but rather soft and weak. 37. Small Ceara biscuits, very resinous, but fairly strong and in fair condition. 39. Fair ordinary Ceara scrap, usual quality. 48. Small Ficus sheet, dead, soft and very weak.

Santa Anita Estate.—1. A good large sample of small amber Hevea biscuits, a little rough in appearance and a little resinous when stretched, this probably owing to the young age of the trees; otherwise very well prepared. 2. A good large sample of small scrappy Hevea biscuits, fair rejections from above. 3. Fair Hevea scrap in balls and biscuits, rather barky, but very free from heat. With less bark would be a very good lot of its grade.

St. Marie's Estate (W. Greig).—41b. Small Funtumia balls, well prepared and in good condition; also three good clean, clear amber biscuits in good condition. Fine quality of this grade, also two small uncured sheets. Would be similar in quality to the biscuits if dried right through.

Tobago.

Louis d'Or Estate (The West Indian Plantation Syndicate).—6. Black Castilloa sheets, good, clean, and well prepared, in good condition, but a little soft and weak. 6a. Similar to No. 6, but very inclined to stick. 7, 8. Black block, clean, well prepared and fairly strong. We recommend sheets rather than block, which has but few friends. 7a. Similar to No. 7. 9. Pressed Castilloa lace or crêpe, fair sample of rubber, clean, strong and well prepared, but would sell better not pressed, but free as No. 9a. 9a. Light and dark-brown Castilloa lace

rubber, good, strong, well prepared, and in good condition, mostly stuck together, but a very fair sample and would sell very well, but perhaps not such a marketable form as sheet. 10. Pressed Castilloa scrap. Black scrap in block form, shows many patches of heat, and not a saleable grade Would be better quite free and free from heat. 10a. Fair ordinary black Castilloa scrap, rather too barky, and slightly heated throughout. Not washed nearly enough, and heated pieces should have been picked out and kept separate.

Easterfield Estate, Tobago (Major Walker).—14. Quite the best sample of Castilloa sheets in the Exhibition. Exceedingly well prepared and in first-rate condition, dark amber in colour, and strong. The small pale sheet attached is good but rather opaque, and not so good as the two larger sheets.

Caledonia Estate, Tobago (H. S. Smith).—12. This is also a very fine sample of Castilloa sheet. Splendidly prepared and in excellent condition, but spoilt by particles of canvas and dust adhering to the back. Otherwise quite as good as the Easterfield exhibit.

Greenhill Estate (H. Hamilton).—15. Small black Castilloa block, well prepared and in good condition, but we would rather see the rubber in sheets, as the Caledonia and Easterfield exhibits. 15a. Similar to above, but rather lighter in colour.

Cocowattie Estate (Hon. H. L. Thornton).—19. Good, clean, strong small and well prepared Castilloa blocks. Very good of its grade, but we would much rather see sheets as Easterfield Estates, and they would sell much more readily and at better prices.

Agenza Estate (E. Cochrane).—3. A very nice lot of smoked Castilloa sheets, some a little mouldy and a few slightly weak, but a very creditable exhibit and a preparation that would sell well on the market. 3a. Smoked, sheet, but quite wet and uncured; not to be recommended at all. If properly dried right through would sell well, and we should think turn out a first-class rubber. 4. Fair ordinary black Castilloa scrap, rather cleaner than usual, but heated here and there. These heated pieces should be picked out, as when left in the heat spreads and spoils good rubber.

Lure Estate (The Trinidad and Finance Co., Ltd.)—20. Very fair Castilloa sheets, good colour, but not sufficiently dried and inclined to stick. We should advise smoking or more thorough drying by hot air or natural means. Except for the drying this sample is excellent.

Franklyn's Estate (D. Macgillivray).—17. A very nice lot of smoked Castilloa sheet, but a little inclined to stick and run together at the edges.

Speyside Estate (H. Tucker).—1. One of the best samples of Castilloa sheets exhibited; good colour and condition strong. A little resinous, perhaps, but an excellent sample.

Richmond Estate (M. Short).—11. Good, clean, brown Castilloa sheets, strong and well prepared, but a little soft, and mostly stuck, and almost inseparable. Would be better smoked.

British Guiana.

Consolidated Rubber and Balata Estates, Ltd.—A large sample of fine West India sheet Balata.

Guiana Balata Co.—Fair pile 1 sheet, but a little rougher than the other exhibits.

Z. Veerasawnny.—2. A good sample of sheet Balata.

Guiana Rubber Co. of America.—Brown washed scrap, Sapium Jenmani, fairly clean, but some very heated and sticky; would be far better in crêpe form. This could be done by a small hand machine on the spot or at a central factory, or even the scrap in the form shown could be put through the rollers to its advantage.

Department of Science and Agriculture.—Small dark amber biscuits of Sapium Jenmani rather deadish and very weak, but when stretched is very resinous and opaque. Transparent before stretching. Would have to be thoroughly tested. Similar to Para biscuit, but apparently very immature.

Department of Science and Agriculture.—Fine small Para biscuits from first tappings of Onderneeming Exploration Station. Good quality and well prepared.

David Young Estates.—A good sample of very dark and black sapium scrappy biscuits. Would be better crêped, but would sell well in this form.

Bartica Agricultural Estate.—Hevea confusa rubber. Very dark biscuits, very dull, soft, and resinous, with no life or elasticity.

Demerara Co., Ltd.—A very fair sample of dark amber Hevea biscuits, well prepared and in good condition, but a little mixed and a little inclined to be resinous and weakish. Otherwise good quality.

Noitgedacht Estate (W. Hodgson).—*a*. Good, strong, clean, well prepared Para biscuits, in good condition. The best specimen on this stand. *b*. Fair crinkley scrap, but part badly heated and rather too barky. All heated pieces and bark should be picked out; the former spoils sound rubber and ruins the parcel for the buyer.

Dominica.

From the Imperial Road.—Thick biscuits of Lagos rubber (*Funtumia*) fairly well prepared, and in good condition, but only partially dried. Too thick, and if rolled out to about $\frac{1}{4}$ inch thick, and dried right through would be a marketable rubber and take a much higher position on the market.

Governor Estate.—One sample similar to above. The other quite wet virgin uncured.

Hatton Garden Estate.—Small resinous biscuits of Funtumia elastica. Should be washed much more thoroughly and rolled out thin, then dried clear and transparent.

POINT MULATRE ESTATE.—*a.* Small uncured lumps and cakes of Funtumia elastica. Should be washed and rolled out thin, then dried clear and transparent. *b.* Large and small, very rough, Castilloa biscuits, wet and quite uncured. This should be washed, then rolled out quite thin, and dried right through. *c.* Rough Hevea biscuits, very resinous, weak, and brittle. Probably from very young trees, and not washed nearly enough.

LONDONDERRY ESTATE.—Large thick Castilloa cakes. Should be washed and rolled out thin, then dried clear and transparent.

CONCORD ESTATE.—Small uncured lumps and cakes. Should be washed and rolled out thin, then dried clear and transparent.

STOWE ESTATE.—*a.* Very rough, porous, and wet cakes, heated and dirty externally, but the rubber is evidently good, and if handled properly could be prepared and improved very considerably. As it is it would rank with the lower mediums. *b.* Small dark Castilloa biscuits, all rather rough and some sticky externally, but some of very good quality and well prepared, but all the rubber is rather soft and weak. Probably young trees.

BOTANIC GARDENS.—*a.* Soft, pasty, uncured Ficus biscuits, some very soft and weak. One or two of the thicker ones are white virgin rubber, and much stronger. There is something wrong with the treatment, possibly want of sufficient washing in cold water. The rubber should be rolled thinner, and dried right through. *b.* Small thick Castilloa biscuits, mostly quite uncured. Smith's machine could probably be used with great advantage. *c.* Rather mixed Hevea biscuits, some are of quite good quality, but all are a little weak. *d.* The second sample of Hevea biscuits from the Botanic Gardens are good, clean, dark amber biscuits, well prepared, and in good condition. The rubber is a little weak, but otherwise this is a very good sample, and by far the best on the stand.

Jamaica.

WINDSOR ESTATE (W. J. D. Hill).—Castilloa sheets, thin, black, roughly-prepared sheets, too thin and very resinous. The rubber is good but badly prepared.

HARTFORD ESTATE (A. Parks & C. Hearne).—*a.* Thin Castilloa sheets, some rough and rather barky, one or two clear and better prepared, all too thin but fairly strong; the rubber is good and only needs more care in preparation. *b.* Scrap, very badly heated and barky, wants washing and picking over.

RURAL VALE ESTATE (C. A. Hinshelwood).—Castilloa large roughly prepared sheets, very barky and resinous; but the rubber is good, and with more care could be very greatly improved.

KONINGSBURG ESTATE (Sir John Pringle, K.C.M.G.)—Castilloa fair black thin sheets, mostly well prepared and in good condition, strong but too resinous and mostly spoilt by chips of wood and bark. We think the use of one of Mr. Smith's machines as used in Tobago could be employed with success in curing this rubber.

HOPE GARDENS.—Brown Castilloa sheets, rather soft and weak and very resinous, rubber good but badly prepared. Smith's machine would be useful on this estate too.—(*West India Committee Circular*, Aug. 1, 1911).

IV.—Report on West Indian Rubber.

I had the honour of being invited to assist in the judging of the West Indian exhibits at the International Rubber and Allied Trades Exhibition and would like to add a few remarks *re* the various samples of rubber shown.

The Jamaica exhibit of the Castilloa variety was almost entirely in the form of thin dark coloured sheets, containing small fragments of bark, &c. These could easily be improved upon by more careful straining and washing of the latex and coagulating the thick washed cream on tightly stretched muslin or fine cloth free from loose hairs and protected from dust. From the statistics the rate of growth of the trees appears very good and if the yield of latex and rubber is satisfactory and the rubber can be put on the market at a reasonable cost, there should always be a demand for this product.

The Dominica exhibit of Castilloa showed greater variation, and some of the thick biscuits were very strong and of good colour. In one case the rubber had a strong medicinal smell, and as far as possible the addition of chemicals should be avoided. Some of the Para exhibits from this colony were rather tacky and pitted, showing faulty methods of preparation, the pitting being due to bacterial development in the latex during coagulation with the liberation of bubbles of gas, which are enclosed in the rubber and burst on rolling. Every precaution should be made to insure absolute cleanliness of all utensils, &c., used in the manufacture, the same as in a dairy. A little formalin in the washing water is advantageous, and Condy's fluid can be sprayed over the floor daily. Formalin as purchased contains 40 per cent., and one part of this solution in forty parts of pure water gives a 1 per cent. solution sufficiently strong for all practical purposes.

Some excellent Castilloa was shown in the Trinidad and Tobago section, including sheets formed by the new separator method, and several good specimens of block. Some of the latter were too thick, manufacturers requiring block not more than one inch thick, as this can be placed in their machinery without cutting, and impurities can be more easily detected.

In the British Guiana section some excellent Para biscuits were shown quite equal to any from the East, also good specimens of balata. The *Sapium Jenmani* rubber could probably be improved in the manufacture as it was a little irregular. The whole exhibit in this section was very comprehensive and well illustrated the possibilities of the Colony. The same may be said for the Dominica and Trinidad and Tobago exhibits, the latter being exceptionally good and complete. The numerous photographs and well illustrated pamphlets give one an excellent idea of the condition of growth of the various rubbers shown and the possibilities of extension in the rubber industry. —(*West India Committee Circular*, July 18, 1911).

J. N. KELWAY BAMBER.

NOTES ON THE PREPARATION OF PLANTATION RUBBER.

The following useful notes were issued by Messrs. Lewis and Peat, of 9 Mincing Lane, London, E.C,. in January, 1911, and are published for general information:—

Lewis and Peat have had so many questions and inquiries regarding the preparation of plantation rubber and as to the most approved form, that they have gathered as much information as possible from various sources and put together the following, hoping it may be useful to planters and help to promote the best interests of the industry generally, and they will be pleased to value samples for planters or answer questions with regard to plantation rubber when desired.

SHAPE AND FORM.

A great improvement in the preparation all round has been evident during the past year and the prices obtained at the fortnightly auctions, have undoubtedly proved that the two most popular forms of preparation are smoked sheets and blanket crêpe, (sheets should be ribbed, thereby allowing a free passage of air on the voyage).

Highlands and Lowlands may be taken as the best example of smoked sheets and Rosehaugh of blanket crêpe, but many other marks run these two very close.

The lower grades in crêpe form, especially the thick and gristly lots, have commanded a ready sale and at times the demand for both brown and black has been extraordinary, buyers greatly appreciating the improved preparation. The scrap crêpe should be thoroughly freed from bark and any pieces shewing signs of heat kept separate.

METHODS OF PREPARATION, COAGULATION, &c.

There seems to be some uncertainty still as to the best method of preparing plantation rubber for the market, but the aim of the producer of course is to put on the market the purest possible article in the most convenient form and prepared at the lowest possible cost to the estate. The coagulating agent in more or less general use is acetic acid, and though other coagulants have been put on the market, acetic seems the best. The aim is to produce rubber containing the smallest quantity of foreign matter and coagulants of all descriptions should be used with the utmost care, and the smallest quantity sufficient to bring about a satisfactory coagulation used. Excessive use of acid in coagulation generally results in a weak and very often unsightly sample.

The question as to whether an estate should manufacture crêpe or sheet rubber greatly depends upon the facilities at hand.

Sheet rubber is still popular with a great many consumers, and the smoked continues to command a premium.

It has been generally noted that sheet rubber that has been made by heavy machinery is very superior to that made by the old hand rollers or mangle, the machine-made sheets showing very few traces of mould or stains, and from what we can gather from planters, are very much easier to deal with in the factory than the hand-mangled sheets.

In smoking the sheet rubber, care should be taken that the sheets are all thoroughly and evenly smoked, and above all, great care should be taken that the smoke-house should not be allowed to become too hot, which results in the charring or scorching of the rubber.

The smoking of rubber generally has not come into vogue as much as we should like to see, but certain estates are regularly sending forward extremely fine lots which are eagerly competed for.

Crêped rubber is now in general demand and used by every manufacturer and is far more easily handled in the plantation factory, and arrives in London generally in a better state than sheet. Of late several estates have been very successful in making thick crêpe in all grades. This crêpe is approximately three times the thickness of the crêpe sent forward hitherto. The method employed to obtain this thick crêpe is to abandon the use of the smooth even-speed rollers for finishing. After crêping and washing in the ordinary way the crêpe should be passed through diamond or grooved rollers of even speed for finishing, care being taken to see that the rubber is not pressed too thin. The result is a strong tough sample of a hard gristly appearance; this method has met with the approval of consumers generally, and we can safely recommend its adoption for all grades, including the scrap and bark qualities. It has been argued that rubber prepared in this way takes a considerable time to dry, and that the size of drying rooms would have to be increased. There is no doubt that thick crêpe does take longer to dry than thin, but being three times the thickness it takes exactly one-third of the space, so what is lost in one way is gained in the other. If thin crêpe is first made and partly dried, the lengths can be laid three or four deep and rolled out again, and made into blanket crêpe of say to a quarter of an inch thick.

With regard to smoked crêpe not much progress has been made, the difficulty being at present that if No. 1 crêpe is smoked it often turns a bad colour and the appearance is not improved; however, we should like to urge planters not to desist in their experiments, as we have a great belief in the future of smoked rubber generally.

While we are on the subject of crêpe rubber, we must warn managers that a good deal of money has been lost through the scrap and bark grades not being sufficiently washed, the presence of small pieces of wood or bark making a difference in value of pence per lb.

It has also been noticed that several samples coming forward have contained small pieces of cotton; this is apparently caused by pieces of cotton waste becoming mixed with the rubber and getting rolled in.

Another point that we should like attention drawn to is that crêpe rubber is continually coming forward showing stains down the edges caused by oil exuding from the bearings of the machines.

We also note that the No. 1 scrap crêpe is very often very streaky. This can be avoided by twisting the lengths while passing through the crêping machine, and an immense improvement in appearance is gained.

We may say, in conclusion, that when dealing with large crops, we think that the making of thick gristly crêpe is extremely hard to improve upon both from the points of view of the producer and consumer.

Block rubber is still being very successfully produced by the Lanadron Company, but this method of treatment has not been generally adopted by other estates.

GRADING AND SORTING.

We cannot too strongly advise planters to pay great attention to the grading and sorting, as if one small piece of inferior or discoloured rubber is found in a package, this piece, however small, is bound to be shown in the sample drawn upon which the rubber is sold.

When grading, standard grades should be fixed upon and strictly adhered to, and pieces which vary in colour should be kept separate.

We should say that two grades are sufficient for sheet, and four, at the outside five, for crêpe, viz., 1 Pale, 2 Brown, 3 Scrap, 4 Bark and Shavings. (It is possible another pile will sometimes be necessary between the Pale and the Brown or between the Brown and the Scrap).

PACKING AND WEIGHING, MARKING, &c.

The packing and weighing of rubber is of the greatest importance and the choice of a suitable packing case is somewhat limited.

Many planters adhere to the Veneer case, the best known make being the "Venesta." These cases have many advantages, being extremely strong, and the wood having a smooth surface there is no danger of loose sawdust or splinters adhering to the contents and spoiling the rubber.

The only disadvantage of this case in the past has been that when once opened for sampling purposes it is difficult to close them down again satisfactorily, but the Venesta Company, realizing this, now makes a special rubber case which obviates this defect. Messrs. Priddy & Hale, Ltd., London, are also making a special patent Veneer rubber case which we think most suitable for the purpose. Other makes of cases that seem to give satisfaction are the Momi and Cochin chests; these have been well tried and the arrival of one in a broken state is most unusual.

In choosing a case for packing rubber the main points to be considered are strength, lightness, and above all that the inside surface of the chest be planed absolutely smooth to avoid the adhesion of splinters to the contents. A case may be rough outside but on no account rough inside.

When weighing in order to ensure the absolutely correct weight being taken, each case should be weighed separately before being filled and due allowance made for the banding-iron and nails used in closing down, as it has been found that the weight of individual cases, although of exactly the same make and appearance varies from 1 lb. to 2 lb., which would mean a considerable variance between the shipped weights and the outturn.

Under no consideration whatsoever should paper, except specially prepared, powder or any other packing be employed in packing rubber.

If it can be avoided the sheets should not be folded when put into the cases. The lengths should be cut to fit and the case should be filled quite full.

The size most commonly used is 19 x 19 x 24 inches, 10 of these exactly making 1 Shipping ton of 50 cubic feet; rubber being shipped by the measured ton, this size is most convenient.

However, now that larger crêping machines are being used it is somewhat difficult to fit the broad crêpe into the above sized chest, and many estates are using a "Venesta" 21 x 21 x 24, which exactly takes two widths of the broad crêpe.

The marking of cases should be done with the utmost care, the gross and nett weights being clearly stencilled on the cases, and when a mark has once been settled upon it is advisable to adhere to it, as buyers, if they find a mark that suits them will always look for it again, and are often willing to improve their bids to secure stuff they have used before and they know will give them satisfaction. When dealing with smoked varieties it is advisable to mark the case clearly with the word "smoked."

SALES.

In selling rubber in London, planters and shippers have the following advantages:—The rubber is sold by public auction and all grades are competed for by British, Continental and American buyers, the lower grades fetching their respective values. The samples are drawn by dock and wharf officials and fairness thereby assured. The same may be said of weights, which are scrupulously taken and shippers' interest protected. To minimise loss in weight after giving out small samples to the trade to get orders the remainder of the samples drawn for the auctions is returned to the cases, and beyond the merchant's commission and the ½ per cent. brokerage, no intermediate profit is made, and the competition of the London auction is recognised as being absolutely straightforward and honest.

The following is an example of a London account sale—say 100 cases plantation rubber.

50 cases	No. 1 crêpe or sheet at	...	...	per lb.
25 ,,	2 ,, ,,	...	...	,,
15 ,,	3 ,, ,,	...	...	,,
10 ,,	scrap or inferior.			

Dock or wharf charges, insurance, &c., come to about ½ per cent., ½ per cent. draft, and discount 2½ per cent., brokerage ½ per cent., and merchant's commission as agreed upon. The ½ per cent. draft and 2½ per cent. discount are allowed to the buyers. There is no duty, and the actual dock charges and payment are guaranteed without any risk to planter or shipper.

Section X.—Manures.

THE PURCHASE OF ARTIFICIAL MANURES.

Manures are often offered for sale in Trinidad at exorbitant prices, and an attempt is made to justify them by statements that they possess a manurial value which cannot be determined by analysis. For example, it is frequently claimed by the sellers of such manures that the nitrogen they contain is of "animal origin" or "derived from organic matter" and on that account possesses some superior manurial value. There has been a good deal of misrepresentation in Trinidad as to the value of manures, and planters would do well to read the following extracts from *Leaflet No. 72* issued by the Board of Agriculture and Fisheries, London. If Trinidad planters would value mixed manures before purchase, they would prevent themselves being imposed upon by unscrupulous vendors. It must be remembered, however, that the cost of manures vary to a certain extent, and that an allowance must be made to cover cost of freight.

"There are three substances, and only three, that are valued in artificial manures, namely, nitrogen, phosphates and potash. According, therefore, to the greater or less quantity of one or other of these substances present the value of the manure will rise or fall. Some manures contain only one of these substances—for instance, nitrate of soda and sulphate of ammonia contain only nitrogen: superphosphate, precipitated phosphate, and basic slag contain only phosphates; and kainit, sulphate of potash, and muriate of potash contain only potash—while other manures hold two substances that are valued, as in the case of bones, which furnish both nitrogen and phosphates, or saltpetre (very seldom used, however, as a manure), which supplies both nitrogen and potash. Only one class of so-called artificial manure, namely, Peruvian or other similar guano, contains an important amount of all three substances.

In trade circulars, price lists, and text books the use of the terms ammonia, phosphoric acid, sulphate of potash, &c., is still common, and in these cases it is well to be familiar with the method of converting them to the legal terms. The common relationships are explained below under the headings NITROGEN, PHOSPHATES, and POTASH.

NITROGEN.

The relationship between nitrogen and ammonia need occasion no difficulty or uncertainty, 17 lb. of ammonia always containing 14 lb. of nitrogen, or, what is the same thing from the farmer's point of view, 14 lb. of nitrogen are the equivalent of 17 lb. of ammonia. If, therefore, a sample of, say "Corn Manure" was said to contain 4·5 per cent. of ammonia, this would be the same as saying that it contained 3·7 per cent. of nitrogen. The figure may be made to look more attractive by being stated as sulphate of ammonia, but this also raises no difficulty, for 66 lb. of this substance are equivalent to 14 lb. of nitrogen or 17 lb. of ammonia. The figures therefore mean one and the same thing, whether they are stated as 3·7 per cent. of nitrogen, or 4·5 per cent of ammonia, or 17·4 per cent. of sulphate

of ammonia. But a manure merchant, who failed to effect many sales for a fertilizer, of ever so high-sounding a name, on a statement of 1 per cent. of nitrogen or 1·2 per cent. of ammonia, might be more successful with a certain class of buyer if he entered the nitrogen as equal to 4·7 per cent. of sulphate of ammonia, and yet the three figures all represent the same fact.

Phosphates.

The relationship between phosphates or phosphate of lime, whether soluble or insoluble, and phosphoric acid, is quite as simple as that between nitrogen and ammonia. 142 lb. of phosphoric acid always form 310 lb. of phosphate of lime; so that to convert the former into the latter one may multiply by 2·2, which, though giving a result slightly above the truth, is quite accurate enough for all ordinary purposes.

If therefore the analysis of a manure should be returned as 12 per cent. of phosphoric acid, it is equivalent to saying that it contains fully 26 per cent. of phosphates. Similarly 30 per cent. of phosphates is equal to nearly 14 per cent. of phosphoric acid.

Potash.

Potash usually exists in manure in the two forms of sulphate of potash and muriate or chloride of potash. It takes 94·2 lb. of pure potash to form 174·2 lb. of sulphate of potash, whereas the same amount of potash will form only 149·2 lb. of the muriate or chloride. In the former case, therefore, to convert potash into terms of sulphate of potash, we multiply by 1·85, whereas in the latter case we multiply by 1·58. If therefore an analysis of, say, kainit is stated as 12·5 per cent. of potash, this is equivalent to saying that it holds over 23 per cent. of sulphate of potash; while muriate of potash guaranteed to contain 56·8 per cent. of potash is of about 90 per cent. purity.

Just as a buyer may sometimes be led into purchasing a manure through its nitrogen being illegally expressed as sulphate of ammonia, so may the contents of potash be made to look more attractive by being stated as sulphate of potash.

The rules for approximately converting the various terms into their equivalents may be summarised thus:—

To	convert	nitrogen............	into	terms	of	ammonia..............	multiply	by	1·2
,,	,,	nitrogen............	,,	,,	,,	sulphate of ammonia	,,	,,	4·7
,,	,,	phosphoric acid	,,	,,	,,	phosphates...........	,,	,,	2·2
,,	,,	potash..............	,,	,,	,,	sulphate of potash..	,,	,,	1·85
,,	,,	potash..............	,,	,,	,,	muriate of potash...	,,	,,	1·58

Nitrogen and phosphates, and, to a less extent, potash, vary in effectiveness, and therefore in value, according to their source or origin. Nitrogen is never so effective as when in the form of nitrate of soda. It is not quite so active, and for some purposes not so valuable, when in the form of sulphate of ammonia, though under certain circumstances this somewhat slower action may be regarded as an advantage. Nitrogen in what is called the organic form is in its least active condition, though here again the rapidity and effectiveness of action vary greatly. Nitrogen is in the organic

form in blood meal, fish meal, bones, shoddy, &c., and yet as a source of plant food blood meal is more active than these other substances. It is claimed as an advantage for slow-acting manures that they last longer, which is true; but one applies manures to act, not to last. It is chiefly where it is convenient to apply manure at somewhat long intervals, as in the treatment of orchards, that the more inert manures are worthy of consideration.

As regards phosphatic manures, it may be said that while soluble phosphates are all alike active, there is considerable difference in the value of insoluble phosphates. The insoluble phosphate of bone meal, for instance, is less effective, and for most purposes less valuable, than the insoluble phosphate of basic slag, or precipitated phosphate. As a manure, however, raw bones have been longer known to British farmers than other forms of phosphate, and apparently for this reason their price has kept relatively high.

The More Important Manures.

The purely Nitrogenous Manures.—The most important of the nitrogenous manures are nitrate of soda and sulphate of ammonia, others in less general use being rape dust, blood meal and shoddy.

Nitrate of soda is generally offered on the basis of 95 per cent. of purity (= 15·6 per cent. nitrogen or 19 per cent. ammonia), while commercial sulphate of ammonia usually contains 97 per cent. of the pure article (= 20·6 per cent. nitrogen or 25 per cent. ammonia). Sulphate of ammonia is thus the more highly concentrated manure.

The purely Phosphatic Manures.—Of the purely phosphatic manures, superphosphate and basic slag are the most important.

Superphosphate contains from 25 to 33 per cent. of soluble phosphate, from 28 to 30 per cent. being a very usual quantity. Basic slag also varies in quality, the usual contents being 35 to 40 per cent. of insoluble phosphate, though there may be as little as 22 per cent., as much as 45 per cent.* Basic slag of inferior quality is often met with, and purchasers should sample this manure and have it analysed.

The Nitrogenous-Phosphatic Manures.—The most important of this class of manures is dissolved bones, though bone meal, fish meal, &c., have their value for certain purposes.

Dissolved bones lose in value through being damp and lumpy; they can, however, be bought as dry and almost as fine as superphosphate. They usually contain 32–34 per cent. of total phosphates (of which more than half should be soluble) and fully 3 per cent. of nitrogen.

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* Note.—The terms soluble and insoluble as used in this leaflet mean soluble and insoluble in pure water. It should be remembered that the water which moistens a particle of manure in contact with the root of a plant is not pure and thus the "water-insoluble" phosphates of basic slag, bone meal and other "insoluble" manures are dissolved and enter the plant. For this reason analysts attempt to imitate the action of soil-water by using a 2 per cent. solution of citric acid as a solvent so that they may obtain a better indication of the value of a manure to a plant than is given by estimating the "water-soluble" and "water-insoluble" phosphates.

Bone meal should be very fine and free from grease. Any particles $\frac{1}{10}$ of an inch or upwards in size become available very slowly. It should hold about 50 per cent. of phosphates, and 4 per cent. of nitrogen.

Potash Manures.—Genuine kainit contains about 12½ per cent. potash, besides which it holds over 30 per cent. of common salt. Where, therefore, a farmer wants to use the latter substance he may find it to his advantage to employ this manure.

Sulphate of potash is offered in various degrees of purity, containing from 25 to over 50 per cent. of potash. Muriate or chloride of potash often holds over 50 per cent. of potash.

Valuation of Artificial Manures.

There are various methods of valuing artificial manures, of which that known as valuation by units is most employed by farmers and dealers. The general trend of prices is determined by market influences, and is largely beyond the farmer's control, but a reliable method of valuation enables him quickly and accurately to conclude which of several samples of the same class of manure is the cheapest. The following figures are given by way of illustration only, inasmuch as prices fluctuate considerably from year to year, and in different parts of the country, owing to a variety of causes.

Sulphate of Ammonia.—A unit is 22·4 lb., or one per cent. of a ton, and since manures are bought and sold by the ton, a unit may be taken as synonymous with one per cent. of the valuable substance in the manure purchased. To find the value of a unit we divide the price of a ton by the percentage composition of the manure. Thus, for example, if sulphate of ammonia contains 20 per cent. nitrogen, and costs say £12 5s. per ton,* the nitrogen works out at $\frac{\text{£12 5s.}}{20} = $ 12s. 3d. per unit. Or as 20 per cent. of nitrogen is equivalent to about 24¼ per cent. of ammonia the cost of a unit of ammonia is 10s. 1d. We can use one or other of these unit-values to enable us to determine which of several samples of sulphate of ammonia is the cheapest. Suppose that we are offered other two samples, the one guaranteed 18½ per cent. and the other 16 per cent. of nitrogen, the price per ton of the former, on the same basis, should be 18½ × 12s. 3d. = £11 6s. 6d. while that of the latter should be 16 × 12s. 3d. = £9 16s. Comparing these figures with the price actually demanded we are able at once to determine which of the three lots of manure is the cheapest.

It may be mentioned that it would be rather exceptional to have the opportunity of obtaining sulphate of ammonia so poor in nitrogen as 16–18 per cent., but dirty samples do sometimes occur, and if the quotation of a price, to include carriage, can be obtained, one can sometimes secure good value in a low class manure, provided the impurities are of a harmless character.

The value of a unit of nitrogen in nitrate of soda is generally rather higher than it is in sulphate of ammonia, which means that farmers regard nitrogen from the former source as rather the more valuable.

* The prices quoted are, wherever possible, those current in February, 1908. Prices of artificial manures, however, are subject to considerable variation.

Nitrate of Soda.—When sulphate of ammonia is selling at about £12 5s. per ton nitrate of soda will cost about £11 5s. On a basis of 15½ per cent. of nitrogen, the value of a unit in the latter case works out at $\frac{£11\ 5s.}{15\cdot5}$ =14s. 6d., that is 2s. 3d. higher than in the case of sulphate of ammonia. If we use this unit to value sulphate of ammonia, we should get the value of a ton as 20 × 14s. 6d. = £14 10s., which is £2 5s. higher than this manure can be bought for when nitrate of soda was £11 5s. per ton. Now, it lies in the power of many farmers to secure this £2 5s. by depending on sulphate of ammonia rather than nitrate of soda where the conditions are specially suitable for the use of the former substance. When sulphate of ammonia costs more, per unit of nitrogen, than nitrate of soda, as occasionally happens, the latter manure is almost invariably to be preferred.

Organic Nitrogenous Manures.—As a rule, organic nitrogenous manures are priced on the market at a much higher rate per unit than is the case with the two manures just considered. The results of their use do not justify this position, for organic nitrogen will not produce so much increase as nitrogen from nitrate of soda or sulphate of ammonia. If we employ 14s. 6d. as the value of a unit of nitrogen in its most effective form (its value in nitrate of soda, February, 1908), and apply it to the valuation of some organic manures, we should get some such results as these:—

Fish Meal, say 8 per cent. nitrogen × 14s. 6d. = £5 16s., together with an allowance of about £1 for phosphates, giving a total value of £6 16s. per ton. Some samples of fish meal hold more and some less than 8 per cent. of nitrogen, in which case the value would rise or fall, though not quite proportionately, on account of the phosphates.

Blood Meal, say 12 per cent. nitrogen × 14s. 6d. = £8 14s., together with about 5s. on account of a little phosphate.

Rape Meal, say 5 per cent. nitrogen × 14s. 6d. = £3 12s. 6d. per ton.

The values per ton for these three manures are usually higher than their merits would appear to warrant. These manures, in fact, are only worthy of a farmer's attention, under ordinary circumstances, when they can be bought at a rate per unit of nitrogen that is considerably less than that which applies to nitrate of soda or sulphate of ammonia, and therefore at a less rate than the figures quoted.

Basic Slag.—Phosphatic manures are also valued in the same way. If at any time the insoluble phosphates in basic slag are valued at 1s. 2d. per unit, a sample containing 40 per cent. would cost 40 × 1s. 2d. = £2, 6s. 8d. per ton, while a 30 per cent. sample would be no better value at £1 15s. As a rule, the lower grades cost more per unit than the higher qualities, so that the latter are usually the better value.

Superphosphate.—Valuing the soluble phosphate of superphosphate at 2s. per unit, a 28 per cent. sample would cost £2 16s. per ton, while a 34 per cent. sample would be as good value at £3 8s. If 1s. 9d. were the rate per unit the cost per ton would be £2 9s. and £2 19s. 6d. respectively.

Bone Meal.—In bone meal—which should only be bought when very finely ground, really dust—the nitrogen is usually valued at about the same rate as that in sulphate of ammonia, while the phosphate may be put at the same rate as that which prevails for basic slag. On this basis, a sample containing 4 per cent. nitrogen, and 50 per cent. insoluble phosphate, would, at the rates assumed above, work out as follows:—

	s.	d.		£	s.	d.
4 ×	12	3	=	2	9	0
50 ×	1	2	=	2	18	4
	Total			£5	7	4 per ton.

Dissolved Bones.—In dissolved bones the market rate for nitrogen may be put at that which prevails for nitrate of soda, while the rate for the insoluble phosphate is usually the same as that in bone meal or basic slag. The soluble phosphate in this manure is exactly the same substance, chemically, as that in superphosphate, and yet it is generally valued somewhat higher. The only justification for this would appear to lie in the fact that the insoluble phosphate, being partly reverted, should be valued somewhat higher than that in raw bone, and raising the rate for the soluble phosphate makes some allowance for this.

Taking these figures, and assuming a good sample of dissolved bones, we come to the following result:—

		s.	d.		£	s.	d.
3 % nitrogen	×	14	6	=	2	3	6
20 % soluble phosphates	×	2	7	=	2	11	8
14 % insol. phosphates	×	1	2	=	0	16	4
		Total			£5	11	6 per ton.

Although this is often about the market rate for dissolved bones, it would appear to be higher than its intrinsic merit warrants.

Kainit.—Kainit can be bought at rather less than 4s. per unit of potash, and in the past spring the price was 3s. 7½d. On an analysis of 12¼ per cent. of potash, therefore, the price of a ton would be 12¼ × 3s. 7½d = (say) £2 4s. 6d.

Sulphate of Potash.—Sulphate of potash, containing 25 per cent. of potash (corresponding to a purity of about 46 per cent.), would be at the rate of 3s. 9d. be worth 25 × 3s. 9d. = £4 13s. 9d.; while high-class manure, containing, say, 50 per cent. of potash (corresponding to a purity of about 92 per cent.) would be worth 50 × 3s. 9d. = £9 7s. 6d.

In point of fact it is generally found that in the higher grades of sulphate of potash the unit value of potash is somewhat higher than that in kainit, so that, with kainit at £2 4 6d. per ton, the market value of sulphate of potash of a purity of 92 per cent. is likely to be about 50 × 4s. = £10.

Muriate of Potash.—This potash manure is usually placed on the market of a purity of 80-90 per cent., corresponding to 50–57 per cent. of

potash. Taking the former quality, and adopting the unit-value of 3s. 6d. (the price prevalent in February, 1908), the price of a ton would work out at 50 × 3s. 6d. = £8 15s.

A unit of potash in muriate is usually valued at a rather lower rate than that in kainit or sulphate of potash. Muriate of potash, in fact, usually offers the cheapest supply of potash, and for most crops it is probably as effective as any potash manure.

Peruvian and similar Guano.—The most important example of a manure holding nitrogen, phosphates and potash, is Peruvian and similar guano. The composition varies within wide limits, but the following may be taken as an example:—

			s.	d.		£	s.	d.
Nitrogen	12%	×	14	6	=	8	14	0
Sol. phosphates	5%	×	2	0	=	0	10	0
Insol. phosphates	15%	×	1	2	=	0	17	6
Potash	2%	×	3	7½	=	0	7	3
			Total			£10	8	9

If the soluble phosphates be valued at the rate assumed for Dissolved Bones the price will work out at £10 11s. 8d.

Such a manure, however, would probably be priced at a higher rate, so that guano, like bones, would appear to be still under the influence of past traditions.

It may be pointed out that the purchase of manures at a certain rate per unit, subject to analysis by an approved chemist, makes a farmer largely independent of variations in quality. If, for instance, he agrees to pay 1s. 3d. per unit, including carriage, for phosphates in basic slag, it is a matter of comparative indifference to him whether the consignment proves to be of 35 or 40 per cent. quality. In the former case the price per ton would be 35 × 1s. 3d. = £2 3s. 9d., while in the latter case, it would be 40 × 1s. 3d. = £2 10s., and the value would be as satisfactory in the one case as in the other. He would be wise not to apply the manure to his land till he was in possession of the analysis, and then he would regulate the dressing with some regard to the quality of the material. A high grade material is desirable, as there is frequently a considerable saving in cartage owing to the fact that a smaller quantity is required.

When a farmer is about to purchase artificial manures, he should always ascertain from the agricultural newspapers the current prices of nitrate of soda, sulphate of ammonia, superphosphate, basic slag, and kainit. From these we can calculate the approximate cost per unit of nitrogen, phosphates, and potash, and thus provide the means of valuing many mixed manures of which the composition is given. Manures composed of low-grade materials may be worth much less than the calculations based on the artificials named would indicate, while they will rarely be worth more.

Valuation a Protection against Fraud.

In one case which was brought to the notice of the Board, an artificial manure offered at £3 10s. per ton was guaranteed to contain 1·25 per cent. of nitrogen, 5 per cent. soluble phosphate, and 1·5 of insoluble phosphate. Valuing these constituents at 14s. 6d., 2s., and 1s. 4d. per unit respectively, the price is practically £1 10s., showing clearly that this manure was offered at an excessive price. In another case the analysis showed a general manure sold at £3 10s. to be worth less than £1 10s.

The farmer who values the manures offered to him in the way indicated in the foregoing pages is not likely to be deceived by such fertilisers as those just referred to. The fact that inferior manures find a ready market in many localities shows how necessary it is that farmers should make it a rule to value before purchasing."

Section XII.—Entomological.

MOSQUITOS AND THE RICE-FIELDS.

Some time ago when travelling on the train past the Caroni rice-fields I was asked by a passenger if this large quantity of water did not provide a rich harvest of mosquitos,—my reply was that, judging by what I knew of the habits of our fresh water fishes, it was quite likely there would be plenty of fish found but *no* mosquito larvæ. However to make certain I would pay a visit to these very rice-fields and test my theory.

Soon after this, in company with Mr. A. J. Pasea I started from Streatham Lodge Estate, where there is a lot of rice planted, and walked towards the Caroni in a southerly direction cutting through the centre of the rice-fields and having to walk mostly on the raised banks that form the boundaries of the "square" fields.

Besides the large number of fishes we saw in these fields there were numerous dragon-flies (*Libellulidae*) which, as is well known, prey upon mosquitos both in the water and on the wing. In their early stages the dragon-flies are voracious aquatic insects: later, when mature and on the wing large numbers may be seen feeding on small flies of all kinds, especially during the wet season.

Several species of fish were seen, including amongst others :—

1. "Millions" (*Girardinus guppyi*).
2. "Small guabin" (*Rivulus harti*).
3. "Common sardine" (*Tetragonopterus maculatus*).
4. "Small sardine" (*Chirodon pulcher*).
5. "Small sardine" (*Corynopoma riisii*).
6. "Coscorob" (*Acara pulchra*).

Fishes are extremely abundant around these rice-fields at all times of the year, I have taken specimens of as many as sixteen species from one pool on the Streatham Lodge Estate.

One of the most useful mosquito-destroying fishes is the "small guabin" (*Rivulus harti*), which can travel considerable distances, so long as the ground is moist, and moreover owing to its powers of leaping is able to reach isolated pools; it is most active in the wet season. This fish ranges from 2 to 4 inches in length and is of very restless habit leaping from pool to pool in search of food.

These fishes all enter the rice-fields from the springs and streams (the Caura and Tunapuna rivers) used for purposes of irrigation, also during any overflows.

It would seem that under such circumstances rice grounds are not a source of danger from mosquitos. On the other hand the planting of isolated patches, such as I have seen in the southern part of Trinidad, the water being collected solely from extensive areas that remain dry for several months in the year, is quite a different matter. There is no way by which a supply of fishes could gain access to such isolated patches, and there is no doubt that under these conditions there would be a source of danger from mosquitos in rice-fields.

P. LECHMERE GUPPY,
Acting Entomologist.

Board of Agriculture.

THE CACAO BEETLE.

Those who have read Mr. P. L. Guppy's "Life History and Control of the Cacao Beetle" (Board of Agriculture, Trinidad, *Circular No. 1.*) will be interested to hear of the number of beetles recently caught by the use of traps recommended by him. Mr. H. Hutton of El Recobro Estate, Caroni, writing on September 18, says that:—

"On August 22, while inspecting a field that was being lightly pruned I noticed several cacao beetles, and in a couple of hours had caught 19. This led me to believe that they must be fairly numerous, and a man was then sent off to cut some trap-wood "Chataigne Maron" (*Pachira aquatica*) which is recommended by Mr. P. L. Guppy in his very valuable work on the subject as a good bait. Next day as a result 108 beetles were captured, and since then the daily catch has ranged between 60 and 500. To-day the total number caught for 26 days is 5,324 which works out at an average of 204 per day. This is the work of one man whose duty it is to set traps and catch the beetles, so the cost has been very little."

Writing again on September 25, he says:—

"The last six days catch of beetles, with the same man, catching, etc., has yielded 2,117, an average of 352 per day. This brings the total to 7,441.

"To get the best results at a moderate cost when the beetles are in the adult stage, I find the following mode of procedure best: choose spots at intervals and at equal distances throughout the estate, and on these do some cutting away that will let in more light than there is in the rest of the field. To do this a little pruning of the cacao trees, say even 100, can be done, or if there are foreign trees (by this I mean anything not Immortels) growing, have them branched and felled. In this way a small clearing will be made and some sap from the cacao trees made to flow. The pruning will of course cause this, and the felling of the foreign trees will break cacao branches and have the same effect.

"It will be found that beetles will flock to these spots for weeks after the clearing has been made, and if "Chataigne" traps are put to the root or fork of every second or third cacao tree there will be little difficulty in collecting them. They are attracted to the spot by the light, and the smell of the sap from the cacao trees and when there, concentrate on the "Chataigne" wood which they much prefer to any other.

"For the traps I find wood from 5 in. to 9 in. in circumference and 2 ft. long best for the purpose. The bark should be lightly shaved from two sides at first, and after about 3 days shave the other two. Every day a light shaving should be done on the sides being used. After a week the traps have become too dry for use, and should be destroyed, fresh wood being substituted. Under the "Chataigne" trees from which the traps have been cut there will be an abundance of small branches, leaves, &c., which will attract a large number of beetles, and careful search should be made for them. A clear space should be made and all the ends dumped on it, so that when they are scattered slightly by the catcher it will be easy to see what beetles there are.

"Gashes made in the trunk of the "Chataigne" tree itself will also help to swell the bag. One intelligent man should be told off to do nothing else than set traps and catch beetles all day. In the early morning few will be caught, but from 9 to 4 o'clock they will be active. As a rule the more sun the bigger the catch. On a wet day few are to be seen."

Of five districts visited by Mr. Hutton recently there was only one where there were no signs of cacao beetles. "This year" he adds, "and at the present time, they are more numerous than I have ever known them in the adult stage." With reference to the above Mr. H. Warner of Waterloo Cacao Estate, Carapichaima, writes on September, 23, "It is also my experience here and the curious thing is that this is not the real cacao beetle season, so far as my experience goes; it is evident that here at least the dry weather during the past three weeks (almost amounting to an Indian Summer) has very much favoured their propagation."

"I have, during the past three weeks caught and destroyed over 3,500 cacao beetles and grubs on this property, but in our case the number of grubs taken out of the trees has largely exceeded the number of beetles caught with traps of "Chataigne Maron" although we have been setting traps regularly for the past three weeks."

The cacao planter has at his disposal a means of controlling the cacao beetle, and now is the time to take action. Concerted action amongst all the planters in a district where the beetle is prevalent would go far towards exterminating the pest.

Section XIII.—Live Stock and Poultry.

EXAMINATION OF THE MILKING CAPACITIES OF GOVERNMENT FARM COWS.

By Herbert S. Shrewsbury, F.I.C.
Acting Government Analyst.

In March an investigation was commenced of the quantity and quality of milk yielded by the cows on the Government Farm. The yield given by each animal was measured and a fair sample of its milk sent to the Laboratory in order that its quality might be valued by analysis.

The results obtained up to date are tabulated below according to breed.

Half Bred Zebu.

Number of Cow.	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
1	4	14·33	8·13	6·20
2	10	14·14	8·94	5·20
3	4	14·12	8·62	5·50
4	6	13·65	8·65	5·00
5	7	13·33	9·53	3·80
6	5	13·24	8·89	4·35
7	5	13·22	9·62	3·60
8	9	13·18	8·78	4·40
9	6	13·10	9·60	3·50
10	8	12·83	8·93	3·90
11	4	12·71	9·11	3·60
12	5	12·70	8·90	3·80
13	10	12·70	8·90	3·80
14	4	12·70	8·70	4·00
15	6	12·60	9·30	3·30
16	4	12·60	9·00	3·60
17	4	12·58	8·68	3·90
18	4	12·46	8·56	3·90
19	5	12·45	8·45	4·00
20	5	12·34	8·74	3·60
21	7	12·28	9·88	2·40
22	9	12·12	9·02	3·10
23	5	12·06	9·01	3·05
24	6	12·00	9·00	3·00
25	4	12·00	9·00	3·00
26	7	11·87	8·87	3·00
27	4	11·85	8·55	3·30
28	5	11·84	8·14	3·70
29	4	11·82	8·97	2·85
30	7	11·79	9·69	2·10
31	5	11·77	9·27	2·50
32	4	11·65	9·15	2·50
33	5	11·40	8·90	2·50
34	4	11·38	8·68	2·70
35	7	11·19	8·24	2·95
36	6	11·17	9·17	2·00
37	5	11·16	8·86	2·30
38	5	11·06	9·26	1·80
39	6	10·31	8·51	1·80
40	4	10·20	8·65	1·55
Average ...	5·6	12·29	8·92	3·37

These cows may be classed as follows according to the quality of their milk:

Fats of 3·5 or more ("very good")		50%
,, 3·0 and upwards but less than 3·5	("good")	17·5%
,, 2·0 ,, ,, 3·0	("poor")	25·0%
,, less than 2·0	("very poor")	7·5%

With regard to quantity of milk, 40 per cent. of the cows yield more than 5 quarts and may be classed as "very good."

The 40 per cent of cows giving "very good" quantities of milk may be again classed as below with regard to the quality of milk given:

"Very Good"	17·5
"Good"	10·0
"Poor"	10·0
"Very Poor"	2·5
	40·0

The milk from 21 is of abnormal character. 2, 4, 5, 8, 9, 10 and 13, are excellent cows, giving large yields of first class quality milk, whilst 15, 22, 24, and 26 are very good cows yielding large quantities of milk of fair quality.

Half Bred Red Poll.

Number of Cow.	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
1	4	14·25	8·75	5·50
2	9	13·54	8·94	4·60
3	6	13·52	8·72	4·80
4	4	13·51	8·41	5·10
5	4	13·42	8·82	4·60
6	6	13·26	10·46	2·80
7	5	12·82	8·82	4·00
8	6	12·70	8·70	4·00
9	5	12·70	8·90	3·80
10	5	12·70	8·70	4·00
11	4	12·49	9·19	3·30
12	4	11·39	8·69	2·70
13	5	11·03	8·73	2·30
Average ...	5·1	12·87	8·91	3·96

Considering this table in the same way, the half bred Red Polls give the following results:—

QUALITY OF THE MILK.

"Very good"	69 per cent.
"Good"	8 ,,
"Poor"	23 ,,
"Very poor"	Nil.

QUANTITY OF MILK.

Very good 31 per cent., consisting of 23 per cent. also very good in quality and 8 per cent. poor in quality.

2, 3 and 8 are thus excellent cows, both in yield of milk and the quality of milk given.

The remaining cows, with the exception of 6 which gives abnormal milk, and of 12 and 13, give milks of good quality, but are rather deficient in the quantity they yield.

Half Bred Guernseys.

Number of Cow.	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
1	5	13·30	8·90	4·40
2	6	12·58	8·58	4·00
3	8	11·94	9·19	2·75
4	5	11·82	8·97	2·85
5	8	11·62	8·62	3·00
6	7	11·40	9·00	2·40
7	7	11·29	9·09	2·20
8	8	10·61	8·56	2·05
Average ...	6·8	11·95	8·99	2·96

Guernsey.

	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
	5	13·18	8·98	4·20

Proceeding as before, we have—

QUALITY OF MILK:

Per cent. of cows, "Very good" 25
" "Good" 12½
" "Poor" 62½
" "Very poor" ... ... Nil.

QUANTITY OF MILK:

Per cent. cows very good 75, composed of:
Per cent. cows giving "very good" quality ... 12½
" " "good" " ... 12½
" " "poor" " ... 50
" " "very poor" " ... Nil.

2 is excellent in quantity and quality of milk. 1 gives excellent quality of milk, but the yield is somewhat below the average.

3, 5, 6, 7, 8 give good yields of poor quality milk.

4 is poor both in quality and quantity.

It is of interest to compare the pure bred Guernsey with the two half bred Guernseys heading the table. Whilst giving no greater yield than 1, the Guernsey's milk is somewhat poorer in quality, whilst 2 though giving somewhat poorer quality milk than the Guernsey, supplies a better yield.

It should be pointed out however, that the Guernsey is a young cow, and may be expected to yield larger quantities of better quality milk later on.

Half Bred Short Horn.

Number of Cow.	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
1	7	12·48	9·08	3·40
2	6	12·35	8·85	3·50
Average ...	6·5	12·41	8·96	3·45

Both these cows are very good in the quality and quantity of milk they yield.

Holstein Breed.

Number of Cow.	Yield in Quarts.	Total Solids. %	Solids not fat. %	Fat. %
1	4	12·08	8·18	3·90
1	4	11·85	8·35	3·50
Average ...	4	11·96	8·26	3·70

This cow yields good quality milk, though the solids not fat are distinctly low. Though the quantity of milk given is poor since the cow is only 4 years old however, she may be expected to improve in this respect.

Comparison of the Breeds.

Breed.	Average yield in quarts.	Composition of average Milk.			% Cows "very good" in quantity of yield.	% Cows yielding "very good" quantity, giving milk of quality.			
		Total Solids. %	Solids not fat. %	Fat. %		"Very good."	"Good."	"Poor."	"Very poor."
Half bred Zebu ...	5·6	12·29	8·92	3·37	40	17½	10	10	2½
Half bred Red Poll	5·1	12·87	8·91	3·96	31	23	...	8	...
Half bred Guernsey.	6·8	11·95	8·99	2·96	75	12½	12½	50	...
Guernsey ...	5	13·18	8·98	4·20	...	..	...	...	...
Half bred Short Horn.	6·5	12·41	8·96	3·45	...	...	...	...	...
Holstein ...	4	11·96	8·26	3·70	...	...	...	...	...

It is obvious that this comparison must not be pressed too far, as the number of Half bred Red Polls and Half bred Guernseys examined was so much smaller than the number of Half bred Zebus. As far as the comparison goes, however, the Half bred Zebu seems to be the best breed, as regards quality and quantity of milk yielded, the 27½ per cent. of cows giving "good" and "very good" milk both in quality and quantity comparing favourably with the figures 23 and 25 for Half bred Red Polls and Half bred Guernseys respectively.

Amongst the Half bred Zebus we have cows giving the best quality of milk and also the largest yields of "very good" quality milk. Unfortunately they also supply the cows giving the poorest yields and poorest quality of milk. There appears a possibility however of producing very fine milking animals by selection from this breed.

THE PEDIGREE OF "MARAT."

A RUMOUR has been current in the Colony that the thoroughbred stallion (hitherto known as "Murat") at the Government Farm was not the animal he was supposed to be. It was therefore considered advisable to obtain the full particulars of his history and pedigree from the Crown Agents by whom he was purchased.

The basis for the rumour is indicated in the following communication dated October 27, 1911, from Mr. John Hill:—

"I have found out that the trouble has probably arisen from the fact that there are two horses, one called "Murat" and the other "Marat." The spelling has been the error. In Dr. Haslewood's letters and those of his Stud Groom the spelling was with a "u." The pedigree is correct, but the name as in Messrs. Weatherley's certificate should read "Marat" spelled with an "a." The horse called Murat, spelled with a "u" is now a *gelding*, Vol. XXI in Stud Book, page 522. He was by "Manbezin" out of "Militia" by "Petronel" and was exported to Germany. In the tabulated pedigree I rather think the name is spelt with a "u," as I gave the name as "Murat" by "Orme" out of "Tragedy," and without further inspection the tabulated pedigree was worked out from the sire and dam. I hope I have now explained it all and that the information will satisfactorily clear up the matter. There can be no possible doubt as to the identity of the horse as the other one is a gelding and exported."

The following is a certified copy of the entry in the *English Stud Book*, Vol. XXI, p. 827:—

> "The brown horse Marat was foaled in 1904, got by Orme, his dam Tragedy by Ben Battle and was sold in 1908 to the Trinidad Government."

Mr. Albert D. Haslewood, Surgeon, of Brixton Derbyshire certifies that Marat was bred by Sir Tatton Sykes, Bart., and sold with his yearlings at Doncaster. Later Marat was purchased by Mr. E. J. Pearcy of

Brayton, Cumberland and was trained but never ran. Mr. Haslewood bought Marat from Mr. Pearcy and sold him to Mr. John Hill of Marsh Brook House, Church Stretton, for exportation to the Government Farm Trinidad, by order of the Crown Agents.

The Crown Agents forwarded Marat's pedigree which is published for general information:

NO. 7 FAMILY.

Marat.

Orme, 11.	3.—Ormonde, 16 ...	7.—Bend Or, 1 ...	15.—Doncaster, 5 ...	31.—Stockwell, 3. 32.—Marigold, 5.
			16.—Rouge Rose, 1 ...	33.—Thormanby, 4. 34.—Ellen Horne, 1.
		8.—Lily Agnes, 16	17.—Macaroni, 14 ...	35.—Sweetmeat, 21. 36.—Jocose, 14.
			18.—Polly Agnes, 16 ...	37.—The Cure, 6. 38.—Miss Agnes, 16.
	4.—Angelica, 11 ...	9.—Galopin, 3 ...	19.—Vedette, 19 ...	39.—Voltigeur, 2. 40.—Mrs. Ridgway, 19.
			20.—Flying Duchess, 3 ...	41.—Flying Dutchman, 3. 42.—Merope, 3.
		10.—St. Angela, 11	21.—King Tom, 3 ...	43.—Harkaway, 2. 44.—Pocahontas, 3.
			22.—Adeline, 11 ...	45.—Ion, 4. 46.—Little Fairy, 11.
Tragedy, 7.	5.—Ben Battle, 4 ...	11....Rataplan, 3 ...	23.—The Baron, 24 ...	47.—Birdcatcher, 11. 48.—Echidna, 24.
			24.—Pocahontas, 3 ...	49.—Glencoe, 1. 50.—Marpessa, 3.
		12.—Young Alice, 4	25.—Young Melbourne, 25	51.—Melbourne, 1. 52.—Clarissa, 25.
			26.—Sweet Hawthorn, 4	53.—Sweetmeat, 21. 54. Alice Hawthorn, 4.
	6.—The White Witch, 7	13.—Massinissa, 17	27.—Flying Dutchman, 3	55.—Bay Middleton, 1. 56.—Barbelle, 3.
			28.—Calpurnia, 17 ...	57.—Ion, 4. 58.—Lysisca, 17.
		14.—Jeu des Mots, 7	29.—King Tom, 3 ...	59.—Harkaway, 2. 60.—Pocahontas, 3.
			30.—Jeu d'Esprit, 7 ...	61.—Flatcatcher, 3. 62.—Extempore, 7.

Section XIV.—Agricultural Education.

HOME READING COURSE EXAMINATIONS.

The Preliminary Examination in connection with the Home Reading Course conducted by the Department of Agriculture was held at the Victoria Institute, Port-of-Spain, on March 18, 1911. Fourteen candidates entered, but only twelve sat for the examination; of these, the following (arranged in order of merit) passed:—

1. George H. Nunez.
2. Shadrach H. Quarless.
3. Adolphe Raphael.
4. George P. Borde.
5. Henry H. Graham.
6. James Reid.
7. James A. Cumberbatch.
8. Henry André.
9. Christopher E. Pilgrim.
10. Franklin Le Blanc.

The questions set were:—

1. What are the physical properties of soils containing a large proportion of sand, clay, and humus respectively?

2. What are the advantages of a good system of drainage?

3. What is the object of mulching soils? Why is it that continuous hoeing may prove beneficial in cases in which mulches cannot be employed?

4. What is the composition of the more important nitrogenous manures, and for what purposes and in what circumstances are they used?

5. What do you understand by the term "vegetative methods of propagation"? Give examples of the commonest methods employed.

6. How may the fact that plants give off water vapour be proved? What role does the water absorbed by a plant play? How does it pass into and through the plant?

7. Describe the pollination and fertilization of plants, state the different ways in which pollination takes place.

8. What are the advantages and disadvantages of pen manure, how should it be prepared and stored?

The Examiner (Mr. A. E. Collens) reported that the majority of the candidates did very well; the first two sent in very good papers. The question on the role of water in connection with plant life, although extremely important, was on the whole poorly answered. He advises candidates in future to pay more attention to grammar and spelling, and give their answers in a concise and (where possible) tabular form, avoiding repetition.

An examination was held at the Victoria Institute, Port-of-Spain, on Saturday, September 9, 1911.

Only one candidate, Harold A. Gordon, presented himself for the Intermediate Examination, and he passed with credit.

The questions were as follows:—

(*Only five questions to be attempted.*)

1. Describe the life history of a scale insect and the chief methods of dealing with these pests.
2. Describe a method of grafting cacao. What are the advantages of grafting?
3. Describe, and give methods of treating, the chief pests of the sugar-cane in Trinidad.
4. Is the carpenter bird useful or harmful to cacao? Give reasons for your answer.
5. Describe exactly how you would lay out an estate in cacao and rubber, assuming the land to be in high woods to begin with.
6. Describe methods of tapping Hevea and Castilloa. Why are the same methods not used for both?
7. Describe the chief fungoid pests of cacao in Trinidad and how to deal with them.
8. Describe the cultivation and preparation of cotton. What are the uses of cotton seed?

Eight candidates sat for the Preliminary Examination, of whom the following (in order of merit) passed:—

1. FitzFrederick A. Farrell.
2. Malcolm B. Williams.
3. Alexander Symister.
4. Irvine E. Reece.
5. Rufus Bynoe.
6. John G. Valverde.
7. Cyril David.

The questions set were:—

(*Only six questions are to be attempted.*)

(*Credit will be given for sketches and diagrams.*)

1. What is the composition of the atmosphere? What changes do plants cause in the atmosphere, (1) in the light, (2) in the dark?
2. Explain why many plants do not thrive in undrained soil and describe methods of drainage suited to (1) flat land and (2) hill sides.
3. What are the chief constituents of farm yard (or pen) manure; and why is it better to have covered pens?
4. Describe the structure of any ordinary flower and the uses of the various parts.
5. Describe, with examples, any methods by which fruits and seeds are dispersed.

6. What kinds of soils are benefited by the application of lime? What action does the lime cause?
7. Describe any method with which you are familiar of propagating plants other than by sowing seeds.
8. Describe the structure of the foreleg of a horse and compare it with the arm of a man.

Candidates are again advised to pay more attention to grammar and spelling, and to draw more sketches; a sketch, even a rough one, will make a description much clearer. Question 4 was on the whole well done, and questions 5 and 7 fairly well done. So many of the answers seemed to be statements learnt by heart, that it was satisfactory to find in the answers to these questions evidence of personal observation. The answers to question 2 were on the whole very poor.

An examination was held at the Court House, Scarborough, Tobago, on September 16, 1911. Six candidates sat for the Preliminary Examination, of whom the following (in order of merit) passed :—

1. Anthony Wood.
2. Eric Blakely.
3. John Paul.
4. Eton Gibbes.

The questions given were the same as those set at the examination held at Port-of-Spain on September 9, 1911. The answers were on the whole very disappointing. Only one candidate drew diagrams; and most of the papers showed a lack of personal observation, especially in question 3, where most of the candidates in describing the constituents of pen manure mentioned the litter, but omitted to mention the essential part of the manure—the droppings of animals.

An examination was held on September 23, 1911. Eleven candidates sat for the examination at the Victoria Institute, Port-of-Spain, and four candidates took the Preliminary examination at Erin on the same day. Out of eight candidates who sat for the Preliminary examination the following (in order of merit) passed :—

1. Sanford Garcia.
2. William Winchester.
3. Remy Goodridge.
4. E. Amoroso.

The questions set were :—

(Only six questions to be attempted.)

(Credit will be given for sketches and diagrams.)

1. What is the proportion of carbon dioxide in the atmosphere? Whence is it derived? and why does it not increase?
2. Describe the characters of a sandy soil and a clay soil. How can the latter be improved?
3. Describe the different manures prepared from bones, giving the average composition of each.

4. Describe the structure of any common seed and the changes which take place during germination.
5. Describe the effects of (*a*) forking and (*b*) rolling, with special reference to the water content of the soil.
6. What is the object of green manuring? How is it carried out and why is it advisable to use a leguminous crop?
7. Describe the structure of any one fruit and explain what relation each part bears to the flower from which it was formed.
8. Describe the alimentary canal of a cow and compare it with that of a horse.

Question 2 was on the whole well done. The question on forking and rolling and the question on green manuring were attempted by all the candidates; in the former no candidate attained more than half marks, and with two exceptions the answers to the latter were poor. Question 4 was attempted by most of the candidates; the answers in many cases showed a lack of observation, which perhaps accounts for the fact that so few made any attempt to draw diagrams of germinating seeds.

Seven candidates sat for the Intermediate examination of whom the following (in order of merit) passed:—

1. Doddridge Davis.
2. Ivan Constantine.
3. Fitz Frederick Farrell.

The questions set were:—

(*Only five questions to be attempted.*)

(*Credit will be given for sketches and diagrams.*)

1. Write a short account of the life-history of any one insect pest with which you are acquainted. Illustrate your answers with sketches.
2. Describe fully how you would prepare and apply any *one* insecticide.
3. Describe the chief fungoid pests of cacao *or* sugar in Trinidad, and how to deal with them.
4. Give a full account of how you would prepare and plant a field of *one* of the following crops—(*a*) cacao, (*b*) sugar, (*c*) coconuts, (*d*) bananas, (*e*) rice, (*f*) rubber, (*g*) limes or (*h*) cotton.
5. Describe fully the manufacture of *one* of the following—(*a*) rum, giving a sketch of the still employed, (*b*) sugar by the vacuum-pan process, or (*c*) sugar by the muscovado process.
6. Describe the different vegetative method of propagation, mentioning a plant which is propagated by each method described. What advantages have these methods over propagation by seeds?
7. Discuss the relative merits of cover crops and clean weeding. What plants would you choose as cover crops?
8. Describe fully *one* of the following—(*a*) preparation of cotton and cotton-seed oil, *or* (*b*) the preparation of copra and coconut-oil.

9. Describe fully how any *one* kind of rubber tree is tapped; also how the latex is coagulated and the rubber prepared for the market.

10. Describe exactly how you would plant up a provision ground, supposing the land to be in bush (secondary growth) to begin with.

The three candidates who passed obtained good marks, especially in questions 2 and 3; questions 1 and 4 were well done by two candidates and the same may be said of question 9. The failure of the other candidates was due partly, no doubt, to lack of knowledge, but chiefly to their not writing down all they knew. For example, in question 3 some candidates gave a list of the chief diseases of cacao, though they were asked to *describe* them; this is all the more disappointing as many of those who made no attempt to describe Black pod, Canker, etc., were able to give an intelligible account of them in the oral examination. In questions 2, 4 and 6, which were attempted by the candidates who failed, the same defects were evident.

Section XV.—Miscellaneous.

TOBAGO CARPENTER BIRD.

The Tobago Carpenter bird (See, *The Carpenter Bird and Cacao*, Department of Agriculture, Circular No. 2) has been identified as *Centurus terricolor*. Six Carpenter birds from Tobago, sent by Mr. W. E. Broadway to the United States National Museum, Washington, D.C., were examined by Dr. C. W. Richmond, Acting Curator of Birds, who furnished the following information:—

> "The birds represent the species *Centurus terricolor*, originally described from the Orinoco region. This species has been long known to occur on Tobago Island, but has not yet been recorded from Trinidad. *Centurus* represents a genus not given in Leotaud's list. The species are rather numerous, and occur chiefly on the mainland of tropical and temperate America, though several occur in the Greater Antilles, and the Bahamas. One of the latter species, *Centurus nycanus*, is said to peck holes in the oranges, and one of our own native species pecks holes in apples and (in Florida) also oranges. However, insects constitute the bulk of the food of these birds, as an examination of the stomach contents will show."

Dr. Richmond suggests that the Bureau of Biological Survey, U. S. Department of Agriculture, may be able at some future date to furnish additional details relating to the food habits of this genus.

The specimens sent by Mr. Broadway have been kept for the Washington Museum.

MINUTES OF THE BOARD OF AGRICULTURE.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, April 21, 1911, at 2.15 p.m.

PRESENT:

His Excellency the Governor (President) *in the Chair*, the Director of Agriculture, the Hons. S. Henderson, W. G. Kay, C. de Verteuil, Lieut.-Colonel J. H. Collens, V.D., Rev. Dr. J. Morton, Messrs. J. d'Abadie, L. de Verteuil, Wm. Greig, H. E. Murray, J. W. Arbuckle, J. B. Rorer (Mycologist), F. W. Urich (Entomologist), P. L. Guppy (Assistant Entomologist), and A. Devenish (Secretary); also Messrs. W. E. Broadway, J. de Verteuil, A. E. Collens, and J. McInroy of the Department of Agriculture.

The Minutes of the meeting of March 17 last, having been printed and circulated, were taken as read, and confirmed. **Minutes.**

Messrs. Fenwick and Wade unable to attend.

The Hon. G. T. Fenwick telephoned asking to be excused from attending on account of pressure of work.

Mr. J. H. Wade sent to say that he intended attending, but was called away at the last moment.

Financial Statement.

The following Financial Statement was submitted:

RECEIPTS:

Balance on March 16, 1911 ...	...	...$ 10,452 44	
Agricultural Tax for March	...	... 2,007 66	$ 12,460 10

PAYMENTS:

Payments to April 20, 1911	...	... ...	2,431 16
Balance in hand...	...	... ...	$ 10,028 94

SPECIAL VOTES:

		Expended to Mar. 31.	Balance in hand.
Sugar Cane Experiments (Froghopper)	($3,022) ...	$ 928 31	$ 2,093 69*
Rubber Tapping Experiments	(3,000) ...	1,502 58	1,497 42
Coconut Palm Destruction	(1,000) ...	849 10	150 90*
Exhibits at Local Shows	(200) ...	142 83	57 17
Prizes for improved Cocoa Cultivation	(960) ...	48 88	911 12
Estates Experiments	(3,720) ...	861 81	2,858 19
Permanent Nitrate Committee Expts	(483) ...	161 49	321 51
Handbook	(456) ...	Nil.	456 00
Blocks and Prints for Illustrations	(200) ...	Nil.	200 00
Total	...	$4,495 00	$8,546 00†

Recomendation of Advisory Committee.

On the motion of the Director of Agriculture seconded by the Hon'ble S. Henderson, the following recommendations of the Advisory Committee dated April 10, 1911, were adopted:—

Sale of horses to Government Farm.

1. C.S.M.P. 371/11. Sale of horses to Government Farm. The sub-committee recommended the purchase of both the Stallion and Mare, at $360 and $200 respectively.

   Recommended.

Mr Brunton's application for increase of salary, &c.

2. Mr. Brunton's application for increase of salary and subsistence allowance.

   Not recommended.

Hon. C. de Verteuil to sign cheques, *vice* Hon. A. Warner on leave.

3. Signing of cheques.

   Recommended that the Hon'ble C. de Verteuil be appointed *vice* the Hon'ble R. S. A. Warner on leave of absence.

The following papers were submitted:—

Re Mr. Guppy's appointment as Asst. Entomologist.

1. C.S.M.P. 626/10. In connection with Mr. Guppy's appointment as Assistant Entomologist for 6 months from January 1 to June 30, 1911.

   Referred to the advisory Committee.

Report of Tobago Farm Committee.

2. C.S.M.P. 1139/11. Report of the Tobago Farm Committee was circulated and the Warden's letter read.

*Due to amounts refunded by Entomologist and Mycologist at end of financial year, on monies advanced them during 1910-1911, for carrying out experiments in out-districts.

†Included in Balance on hand of $10,028 94 on April 20, 1911.

On the motion of Lieut.-Colonel Collens, seconded by Mr. d'Abadie, the report of the Farm Committee was adopted, the facts contained in the Warden's letter having been considered by that Committee.

Sporting Chronicle on Mr. McInroy at Govt. Farm.

Mr. Henderson asked His Excellency's permission to allow Mr. McInroy to refute the statement made against him in the *Sporting Chronicle* for the information of the Public. His Excellency said that the matter had already been brought to his notice and that he had no objection.

Mr. McInroy emphatically refuted the statements made and said that he would be only too glad if any persons who wished would visit the farm and see the sanitary way in which the milking, &c., was carried out.

Alteration of Rules in prize for improved cacao cultivation.

3. C.S.M.P. 1844/11. Rules in connection with the Prizes for improved Cacao cultivation. Alteration of Rules by sub-committee, viz. :—

1. That the date for entries should be extended from March 31 to April 30.
2. That the word "cultivating" should be substituted for "owning" (the 3rd word in Rule 2.)

On the motion of the Director of Agriculture seconded by the Rev. Dr. Morton the sub-committee's recommendation was adopted. Messrs. Plummer's and Brunton's progress reports stating the number of competitors to date were read.

Mycologist's Report.

4. Mycologist's report.

The Mycologist said :—"During the past month I have made pickings from the sprayed Cacao plots at both Guanapo and Sangre Grande, and in each case there has been a decided advantage shown in the results from the sprayed Cacao. Over 1,000 more pods were picked from the sprayed trees at Sangre Grande than from the unsprayed trees. In the pickings which are made at this time there is very little black cacao, this is no doubt due to the dry weather which makes it impossible for the fungus to get a foothold. I have recently received a Bulletin from Ceylon written by Petch the Mycologist there in which is given a report on cacao canker. You may remember the first work on cacao canker was done in Ceylon, and the disease attributed to a species of Nectria. This original Ceylon work has been the basis of all work on cacao canker in different countries until early last year when I called attention to the fact that canker in cacao trees could not be produced by inoculation with pure cultures of any species of Nectria which I had found here on diseased cacao pods and bark. This led to a thorough investigation of the disease and as you know I have proved beyond a doubt that the common canker and black pod disease are really one and the same thing, and caused by a species of Phytophthora and not a Nectria.

I am glad to report that Petch has repeated many of the inoculation experiments which I made and described in my paper on Canker, and has come to the same conclusions which I reached last year, viz. :—That the Cacao canker in Ceylon is due to Phytophthora and not Nectria as had long been supposed. Petch has also found that this same fungus is able to attack Hevea Rubber and in places where this tree is planted intermixed with Cacao it becomes so seriously diseased that it cannot be tapped with any profit. The fungus attacks not only the fruits but the bark as well

forming large areas of diseased tissues similar to that found on Cacao trees. It would be well for all those who intend planting rubber here in Trinidad to bear this fact in mind. Discoloured areas of bark have been sent to me from Hevea rubber trees at Longdenville and it is quite possible that this is due to Phytophthora although I have not succeeded in isolating fungus from the diseased tissues.

I would like also to call your attention to the prevalence of nematodes in the soil of many places here in Trinidad. These worms have made it impossible to grow certain cover crops successfully at the Botanic Gardens and may prove a serious pest in some places. Specimens of galls produced by these worms were shewn.

Entomologist's Report.

5. Entomologist's Report.

The Entomologist said in regard to Froghoppers. On account of the dry weather there are now very few Froghoppers about. From abandoned fields or traces overgrown with grass 6 trap lanterns during last month yielded from 5 to 40 specimens per night.

Castnia Licus.—The number of moths caught in the Caroni District is more than in the corresponding months of the last year. In March, 1909, it was 4,812. In 1910. 1,537 and this year 2,517. These figures vary on account of the state of the weather, as during very dry weather fewer moths escape from the chrysalis stage. On the whole fewer moths were caught in 1910 than in 1909. The numbers are 1909, 180,734, and in 1910, 116,707.

It is a pity that estates in Trinidad cannot be flooded after the canes are cut, as this would be a good way to destroy caterpillars remaining in the cane stools.

Cacao Pests—Mr. Guppy's final paper on the Cacao beetle is in the press and will be issued shortly. He is now engaged on the life history of the pod hoppers, *Horiola* species. It appears that certain species of ants are very partial to the secretions of these insects and in consequence they are protected, and the natural enemies kept away to a certain extent.

Coconut Pests--The Bearded Weevil. I have to report that I found the bearded weevil attacking apparently healthy trees. On a very large estate where I spent two days, I only noticed three trees close together that had been attacked. They showed exit holes of the adult beetles at about 3–5 feet from the ground and one tree showed recently laid eggs. The larvæ of this beetle burrow horizontally through the tree and as far as I could see on these particular trees did no damage beyond weakening the trees so that strong winds might cause them to break at the point of attack. There is however no doubt that the beetles prefer diseased trees. I found such a tree and from it I collected no less than 6 adult beetles and I counted over 100 eggs that had been laid. A fully illustrated report is in course of preparation, but in the meantime any coconut trees not otherwise diseased showing exit holes of adult beetles should be painted with a strong solution of arsenate of lead as the female beetle gnaws the bark of the tree before depositing her egg. I would be glad to hear from any planter who finds healthy trees attacked by this beetle.

Scale Insects of Coconuts.—The scale insect, *Aspidiotus destructor*, is found all over the Island where coconuts are grown. When the attack is a bad one all the parts of the tree excepting the roots and old bark are covered with insects in all stages of development. I have noticed however that on young trees, *i.e.*, fairly low ones, the scales are not as numerous as on tall trees and on trees not containing nests of an *Atzeca* species of ant. On low trees the scales appear to be kept under control by a small beetle, and about Port-of-Spain I have observed small chalcid parasites on the scales. It would therefore appear as if the ants prevented the parasitical insects from doing their work. The first step would be to destroy the ants on the tree so as to give the parasites a chance.

Brassolis or Coconut Butterfly.—A few nests of these caterpillars were noticed. Up to now they cannot be said to be serious pests in Trinidad but whenever seen the nests should be destroyed.

Visit to Tobago.—I visited Tobago from March 21 to 23 and while there paid most attention to the coconut plantations within easy reach of Scarborough. I found no Bearded Weevils nor Rhinoceros Beetles, and few traces of Grugru Beetles. Scale insects were present but not in large numbers and their natural enemies were observed. No *Brassolis* were seen. On the whole I was impressed by the absence of insect pests on the estates I visited. Through the kindness of the Warden I addressed a meeting of school teachers in connection with nature study with special reference to insects, and I did this with the object of getting the school children interested and through them the small proprietors. It was not possible to hold a meeting of the Planters' Association at the time I was there.

Vote of £25 for Mosquito Illustrations.

Board's officers can serve on Agricultural Society's Committees.

The Entomologist asked for a vote of £25 for illustrations for his paper on mosquitos. On the motion of Mr. Murray seconded by Lieut.-Colonel Collens, it was granted. The Entomologist stated that both he and the Assistant Entomologist had been put on a Committee of the Agricultural Society in connection with animal parasites—and asked for the approval of the Board; it was decided that the Board would have no objection to their Officers serving on such Committees.

Vote of £25 for 2 years to B. of I. T. for farriery classes.

6. Mr. R. H. Marwood's (Chairman of Examination and Technical Instruction Committee Board of Industrial Training) application for a grant of £20–£25 per annum, for two years, for Farriery Classes in the Country.

On the motion of the Director of Agriculture, seconded by Mr. L. de Verteuil a grant of £25 per annum for 2 years was agreed to. His Excellency the Governor begged personally to thank the Board for granting the amount, especially as he was the one who had been instrumental in bringing the matter before the Board of Industrial Training.

Report of Grenada Committee on Economic Industries, &c., 1910.

7. Report of the Committee on Economic Industries, etc., Grenada, 1910.

The Secretary was directed to ask the Government to be good enough to supply the Board with 25 copies for distribution to the Members of the Board, and if necessary the Board to pay for same.

Plans for New Buildings for Board of Agriculture.

8. C.S.M.P. 7434/10—Plans of New Buildings for Board of Agriculture. Referred to the Advisory Committee.

Progress Reports by Mr. J. de Verteuil on Manurial Experiments.

9. Progress Reports.

Manurial Experiments: Mr. J. de Verteuil.

Rubber Tapping Experiments: Mr. W. E. Broadway. Mr. A. E. Collens.

Mr. J. de Verteuil gave details of the progress of the Manurial Experiments, and asked for a further supply of 1½ tons of Nitrate of Soda and 1½ tons of Sulphate of Ammonia.

Agreed to.

Mr. W. E. Broadway on Rubber Seeds received from the Malay States.

Mr. Broadway reported on the Hevea Seeds received from the Malay States, and gave the following figures:—

32 cases containing 384,000 seeds received here on March 1, only 313 have germinated up to date, April 20, 1911.

12 cases containing 144,000 seeds received here on March 12, only 233 have germinated up to date, April 20, 1911.

28 cases containing 336,000 seeds received here on March 29, only 73 have germinated up to date, April 20, 1911,

Mr. Collens on Rubber tapping in Tobago.

Mr. Collens reported on his visit to Tobago, and said that out of 50 Castilloa Rubber trees tapped records of 30 were at hand. 14 year old trees measured from 60 to 86 inches in circumference and yielded on an average 10 ounces; 10 year old trees measured from 50 to 70 inches. The average yield of all the trees amounted to 7 ounces of dried rubber each.

The trees were tapped ⅓ of their total area, up to 18 feet high. Bamboo ladders were used and Smith's system was followed. Photos and sheets of rubber were exhibited, showing the method of preparation.

Monthly Reports by Mycologist.

10. Monthly reports from the Mycologist.

Circulated and laid on the table.

After thanking the Members for their attendance, His Excellency the Governor adjourned the meeting to Friday May 19, 1911.

A. DEVENISH,
Secretary.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday, May 19, 1911, at 2.15 p.m.

PRESENT:

His Excellency the Governor (President) *in the Chair*, the Director of Agriculture, the Hons. G. T. Fenwick, C.M.G., and C. de Verteuil, Lieut.-Col. J. H. Collens, V.D., Rev. Dr. J. Morton, Messrs. J. d'Abadie, Wm. Greig, J. J. McLeod, J. H. Wade, J. W. Arbuckle, J. B. Rorer, (Mycologist), F. W. Urich, (Entomologist), P. L. Guppy, (Asst. Entomologist), and A. Devenish, (Secretary), Messrs. W. G. Freeman, J. McInroy, J. de Verteuil, and A. E. Collens of the Department of Agriculture, were also present, also Mr. Lamont.

The Minutes of the meeting of April 21 last, having been printed and circulated, were taken as read, and confirmed. Minutes.

His Excellency said that before going into the other matters of the meeting he would like very much to welcome Mr. W. G. Freeman, the new Assistant Director of Agriculture, and to introduce him to the Members of the Board. Welcome to New Assistant Director.

Mr. Freeman suitably thanked His Excellency for so doing.

The following letters were read:— Messrs. L. de Verteuil, J. Moodie and W. Kay unable to attend.

From Messrs. L. de Verteuil and J. Moodie regretting their inability to attend.

Professor Carmody said that Mr. Kay also begged to be excused on account of pressure of work.

The following Financial Statements was submitted:— Financial Statement.

RECEIPTS.

Balance on April 20, 1911	...$10,028 94	

PAYMENTS.

Payments to May 19, 1911		$1,718 00
Balance in hand		$ 8,310 94

SPECIAL VOTES.

			Expended to April 30.	Balance in hand.
Sugar Cane Experiments (Froghopper)	($3,022)	...	$1,105 51	$1,916 49
Rubber Tapping Experiments	(3,000)	...	1,497 58	1,502 42*
Coconut Palm Destruction	(1,000)	...	849 10	150 90
Exhibits at Local Shows	(200)	...	142 83	57 17
Prizes for improved Cacao Cultivation	(960)	...	50 08	909 92
Estates Experiments	(3,720)	...	973 81	2,746 19
Permanent Nitrate Committee Expts.	(483)	...	156 37	320 66*
Handbook	(456)	...	80 36	375 64
Blocks and Prints for Illustrations...	(200)	...	174 93	25 07
Mosquito Illustrations	(120)	...	Nil.	120 00
Board of Indus. Training (Farriery Classes for two years) ...	(240)	...	Nil.	240 00
Total		...	$5,030 57	Tot'l $8,364 45†

* Due to amounts refunded by Jackbill at the end of financial year on money advanced him for building a house at Longdenville, and refund on Nitrate bags by Smith Bros. & Co.

† Included in Balance on hand of $8,310 94 on May 19, 1911.

STATEMENT OF REVENUE AND EXPENDITURE FROM APRIL 1, 1910, TO MARCH 31, 1911.

Receipts.	$ c.	Expenditure.	c.
To Balance in hand on April 1, 1910...	$12,691 20	By Salaries ...	$11,649 96
,, Agricultural Tax on Cacao	10,558 82	,, Laboratory	1,322 26
,, ,, ,, Sugar	3,040 52	,, Library ...	474 23
,, ,, ,, Coconuts	1,150 36	,, Office Con'.	180 94
,, ,, ,, Copra	298 02	,, Disease Prev.	355 93
,, 250 lb. Arsenate of Lead sold to A. Stollmeyer. (Disease Prevention).	24 60	,, Illustrations, &c.	563 24
		,, Travelling	1,031 42
,, Refund by Jackbill, amount advanced him for building house, Longdenville Rubber Experiments.	5 00		
		Recurrent Expenditure	$15,577 98
,, Permanent Nitrate Committee for Experiments with Nitrate of Soda (*See* Minute November 18, 1911).	483 00		
		SPECIAL VOTES.	
		By Exhibits ...	142 83
		,, Coconut Palm Destruction	662 75
		,, Froghopper	919 59
		,, Rubber Experiments	1,496 33
		,, Estate Experiments	861 81
		,, Prizes for Improved Cacao Cultivation	48 88
		,, Permanent Nitrate Committee	161 49
			$19,871 66
		,, Cash at Colonial Bank	8,362 75
		,, Cash on hand	17 11
	$28,251 52		$28,251 52

(Sd.) A. DEVENISH,
Secretary.

May 3, 1911.

Examined and found correct.

(Sd.) CHS. PANTIN,
Acting Auditor-General.

May 4, 1911.

On the motion of the Hon. G. T. Fenwick seconded by the Hon. C. de Verteuil, the following recommendation of the Advisory Committee dated May 19, 1911, was adopted. Recommendation of Advisory Committee.

C.S.M.P. 626/10. In connection with Mr. Guppy's appointment as Assistant Entomologist for 6 months, from January 1 to June 30, 1911. Mr. Guppy re-appointed Assistant Entomologist for 6 months.

Recommended that he be re-appointed for a further period of six months, from July 1, 1911, to December 31, 1911, subject to the Governor's approval.

The following papers were submitted :—

1. Estimates of Receipts and Expenditure, River Estate 1911–12. Estimate of River Estate 1911—12.
   Approved.

2. C.S.M.P. 3265/11. $4,800 asked for, by the Manager, River Estate, to buy in 25,000 trees in the hands of contractors. Manager River Estate, application for $4,800 to buy in contracts.
   Referred to the Advisory Committee.

3. Estimates of Receipts and Expenditure, St. Augustine Estate 1911–12. Estimate of St. Augustine 1911-12.
   Approved.

4. C.S.M.P. 6002/10. Copy of a despatch from the Secretary of State for the Colonies—*re* co-operation by the Crown Colonies with the African Entomological Research Committee. *Re* Co-operation by Crown Colonies with African Entomological Research Committee.

A letter from Mr. Urich, the Entomologist, giving his views as to how the co-operation could be carried out was also read.

To be circulated before the next meeting.

5. Department of Agriculture—Reports by Officers. Reports by the officers of the Department of Agriculture.

Mr. de Verteuil reported on the manurial experiments and gave details as to the progress of same. Mr. de Verteuil on manurial experiments.

Mr. Collens reported on Rubber tapping at St. Marie, Cedros, and Non Pareil, Arima, and gave a detailed statement of the yield of the different trees tapped. He also exhibited samples of the rubber and photographs of the places. Mr. Collens on Rubber.

The Director of Agriculture laid on the table a few books on the Standardization of different products in Canada, also catalogues of Rubber Machinery for preparing crude rubber. The Director Standardization—Catalogues of Rubber Machinery.

He said that the trotting stallion had been purchased by the Farm, as was recommended by the Board. Hybrid cotton had been planted at St. Augustine; it seems to have taken all right, and can be now seen in bearing, by anyone who would like to. Samples of rubber had been collected for the Exhibition in London and were handed over to the Permanent Exhibition Committee. Trotting Stallion Farm. Hybrid cotton St. Augustine. Samples of rubber for London Exhibition.

The Agricultural Inspectors had sent in the list of applicants for the prizes for improved Cacao Cultivation, the totals amounted to 300 in the Sangre Grande district and 128 in the Caparo district. Agricultural Inspectors on prize scheme, list of competitors.

Paper manufactured at Tacarigua.

Samples of the paper manufactured at the Tacarigua Factory were exhibited by him and he had been informed that the paper could be made a commercial success.

Hevea seeds received by Department.

Out of 864,000 Hevea seeds imported by the Department at a cost of £370 16 0, only 1,626 had germinated.

Annual Report to March 31, 1911, by officers of the Board.

6. Annual Report ending March 31, 1911, by the Officers of the Board.

Having been circulated, were laid on the table.

Mycologist's Report.

7. The Mycologist's report:—

The Mycologist said since your last meeting I have prepared a report which briefly covers the work which has been done during the past year. This report has already been circulated.

I spent the first 10 days of this month in Tobago devoting my attention more particularly to coconut diseases, especially the so called root disease. I have as yet been unable to find any parasitic fungus in connection with this disease so that it would seem to be due to a great extent to unfavourable soil conditions. This disease has been found most frequently in soil which has been repeatedly cropped with sugar-cane before the coconuts were planted, or on hill sides which have been burnt off, cropped with vegetables and finally planted with coconuts. It is quite possible that by judicious methods of cultivation and the use of manures this disease may be overcome.

So far as I have been able to see, Tobago is remarkably free from fungus diseases.

Entomologist's Report.

8. Entomologist's Report.

The Entomologist said, I beg to submit my Annual Report for the past year. I would like to call your attention to the passage on page 8 relating to *Aspidiotus destructor*, or the coconut scale. There appears to be a relation of certain ants to the scale by which the latter are protected and so are apt to increase in numbers. The ants are greatly encouraged by the numerous cutlass chops on the trunks of the coconut palms, and in the Cedros district I noticed that nearly every cutlass scar on many trees contained a colony of the ants. Would it be possible to impress on coconut pickers that trees are not to be used as temporary stands for their cutlasses? Some experiments have just been started at Mayaro and some will be done at Icacos, in connection with spraying for ants and scale insects, and I hope that by next meeting I will be able to report some results to you. Frog-hoppers continue to be scarce and on three occasions none were caught by trap lights; the numbers vary from 1 to 23. The rainy season is not too far off and when it sets in the small leaf eating beetles of cacao will increase. For those Planters who would like to try the experiment I would recommend the addition of 4 to 5 lbs. of Arsenate of lead to every 50 galls. of Bordeaux mixture. The young leaves at the ends of the branches should be sprayed. Mr. Guppy's paper on the Cocoa beetle had been distributed by the Department of Agriculture.

Letter from Mr. Bovell—*re* manurial experiments—Nariva Cocal.

9. Letter from Mr. Bovell—In connection with Manurial Experiments at the Nariva Cocal.

A letter offering to pay for the manure used on plot 1, and the expenses for returning the unused balance, as he did not see his way to carry out the experiments on account of the scarcity of labourers, was read.

Referred to the Advisory Committee.

Professor Carmody said that he intended going on leave from May 31, and would be present at the Rubber Exhibition in London. His Excellency in the name of the Board, wished him as Vice-President, *bon voyage* and a pleasant holiday. Professor Carmody's leave of absence.

After thanking the Members for their attendance, His Excellency the Governor adjourned the meeting to Friday, June 16, 1911.

A. DEVENISH,
Secretary.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday June 16, 1911, at 2.15 p.m.

PRESENT :

His Excellency the Governor (President) *in the Chair*, the Acting Director of Agriculture, the Hons. G. T. Fenwick, C.M.G., C. de Verteuil, and W. G. Kay, Lieut.-Colonel J. H. Collens, V.D., Messrs. J. Moodie, L. de Verteuil, J. P. Bain, Wm. Greig, J. H. Wade, J. W. Arbuckle, J. B. Rorer (Mycologist), F. W. Urich, (Entomologist), P. L. Guppy, (Assistant Entomologist), and A. Devenish, (Secretary). Messrs. J. de Verteuil, and A. E. Collens of the Department of Agriculture, were also present.

His Excellency the Governor said that having only just received the information of the death of Mr. Murray's son, he was sure that all the Members would join with him in sympathising with Mr. Murray over his sad loss. *Re* death of Mr. Murray's son.

The following letter was read :—

From Mr. Norman Lamont dated 12th instant, regretting his inability to attend the meeting as he would be away from the Colony from June 13, to early in January, 1912. Leave of absence to Mr. Lamont.

Leave approved.

His Excellency said that he would like to let the members know that he had received a letter from Dr. Watts, the Imperial Commissioner of Agriculture, asking if the West Indian Agricultural Conference could be held in Trinidad sometime in the latter part of January, 1912, as the arrangements for its being held in Demerara had fallen through. He had replied to Dr. Watts that the Government would be very pleased if the Conference is held in Trinidad and proferred a wish from the Agricultural Society that if possible the Conference might be held at the time of the Agricultural Society's Show at the end of January. West Indian Agricultural Conference to be held in Trinidad in January, 1912

On the motion of the Hon. G. T. Fenwick, seconded by the Acting Director of Agriculture, it was resolved that the Imperial Commissioner of Agriculture be informed that the Board is pleased to hear that there is a

probability of the West Indian Agricultural Conference being held in Trinidad in January, 1912, and that it would be a great advantage if it could be held during the Agricultural Society's Show at the end of January.

Financial Statement.

The following Financial Statement was submitted :—

RECEIPTS :			
Balance on May 19, 1911	...$ 8,310 94		
Agricultural Tax for April	... 2,051 30	$ 10,362 24	
PAYMENTS :			
Payments to June 16, 1911		1,285 00	
Balance in hand		$ 9,077 24	

SPECIAL VOTES :

		Expended to May 31.	Balance in hand.
Sugar Cane Experiments (Froghopper)	($3,022)	...$ 1,118 57	$ 1,903 43
Rubber Tapping Experiments	(3,000)	... 1,497 58	1,502 42
Coconut Palm Destruction	(1,000)	... 849 10	150 90
Exhibits at Local Shows	(200)	... 142 83	57 17
Prizes for improved Cacao Cultivation	(960)	... 50 08	909 92
Estates Experiments	(3,720)	... 1,119 41	2,600 59
Permanent Nitrate Committee Expts.	(483)	... 156 37	320 66
Handbook	(456)	... 80 36	375 64
Blocks and Prints for Illustrations	(200)	... 199 50	50
Mosquito Illustrations ...	(120)	... Nil.	120 00
Board of Industrial Training (Farriery Classes for two years).	(240)	... Nil.	240 00
Total ...	$13,401	...$ 5,213 80	$ 8,181 23*

Recommendations of Advisory Committee.

The following recommendations of the Advisory Committee were adopted :—

Plans for New Buildings for Board of Agriculture.

1. C.S.M.P. 7434/1910. Plans for New Buildings for Board of Agriculture. The Director of Public Works recommends that a fee of $40 for drawing the plan, be allowed the draftsman, who will do it in his spare time, and under the direction of the Director of Public Works and the Engineer Office and Works.

   Recommended.

Manager River Estate—Application to the Government for $4,800 for purchase of Contracts, &c.

2. C.S.M.P. 3265/11. Application from Manager, River Estate, for $4,800 for purchase of Contracts and General Improvements.

   Referred to River Estate Committee for inspection and report.

Mr. Bovell's letter on Manurial Experiments at Nariva Cocal.

3. Letter from Mr. Bovell—*re* Manurial Experiments at the Nariva Cocal.

   Recommended that he be offered the manure sent him, at cost price, plus freight charges; in the event of his not accepting, recommended that the unused manure be sent on to Mayaro for experiments on one of the Estates, there, and that no charge be made for the small quantity used by Mr. Bovell.

* Included in Balance on hand $9,077 24 on June 16, 1911.

4. C.S.M.P. 5571/09. In connection with the payment for the Para Rubber seeds received from the Malay States.

Re payment of account for Para Rubber seeds from Malay States.

Recommended that the account for £370 16 be not paid, as the Trinidad Government's instructions were not complied with.

The following papers were submitted:—

1. C.S.M.P. 6002/10. Copy of a despatch from the Secretary of State *re* co-operation by the Crown Colonies with the African Entomological Research Committee.

Co-operation of the Crown Colonies with the African Entomological Research Committee.

Postponed—being still in circulation among the members.

2. C.S.M.P. 3341/11. Appointment of Mr. Norman Lamont as a member of the Board.

Appointment of Mr. Lamont as a member of the Board.

Laid on the table.

3. Letter from Mr. T. Thornton, Tobago, asking to have meetings of the Board on Friday of Mail week.

Mr. Thornton, Tobago, asking for Board's meetings to be held on Mail week.

Mr. Thornton to be informed that on account of the meetings of the Agricultural Society having been fixed for second Friday of each month, the Board also wanted a fixed day, and it was unanimously decided that the meetings take place on the 3rd Friday of each month.

4. C.S.M.P. $\frac{3520/11}{1345}$ Capt. Benson's offer to lecture on Trinidad and Tobago, in England, for £250—asking the Board if it will be prepared to contribute towards the cost of lectures.

Capt. Benson's offer to lecture on Trinidad—*Re* Board's contribution.

The Hon. G. T. Fenwick moved, seconded by the Hon. W. G. Kay, that the Board should not contribute towards the cost of the lectures.

The Hon. C. de Verteuil, seconded by Lieut.-Colonel J. H. Collens, moved an amendment that £100 be contributed. On being put to the vote, the amendment was lost.

5. C.S.M.P. 4769/10. International Rubber and Allied Trades Exhibition, London—Catalogues and Copies of Literature, &c., for distribution at the Exhibition, prepared by the Permanent Exhibition Committee.

Catalogues, &c., by Permanent Exhibition Committee for distribution at Rubber Exhibition in London.

Laid on the table, and the Secretary was directed to thank the Permanent Exhibition Committee for all they had done.

6. Mycologist's Report.

Mycologist's Report.

The Mycologist said:—

Since the last meeting I have made a picking from the sprayed cacao plots at Sangre Grande, and these pickings bear out the results which I obtained last year. From 1,000 sprayed trees 7,736 good pods were picked, while from an adjacent 1,000 trees which were not sprayed, only 4,470 pods were picked. That the spraying has had a cumulative effect is shewn, I think, by the results from 2 sprayed plots of 500 trees, one of which was sprayed last year and again this year, while the other plot was

sprayed for the first time this year. The plot which was sprayed both years yielded 4,120 pods while the other plot which was sprayed for the first time this year yielded only 2,500 pods. On this present crop in the last two pickings 13,896 pods have been picked from 1,000 sprayed trees, while from 1,000 adjacent unsprayed trees only 8,470 pods have been picked. Before the next meeting I hope to have a Bulletin published which will give all the figures in detail, the methods of spraying used, and the cost.

I spent 9 days at Cedros, during the early part of the month for the purpose of continuing my investigations of the coconut root disease which is prevalent in that district. In all I have made over 300 cultures from diseased roots, but as yet have been unable to find any parasitic fungus in them which will cause the disease when inoculated on healthy trees. On this trip I found a fungus different to any which I had obtained before and with which I am now making inoculations. Whether this fungus will prove to be parasitic cannot as yet be told. I am preparing to start an active campaign with the Froghopper fungus during this coming season to determine whether or not it can be used as a means of controlling this pest. The best method of using the fungus, I think, will be that which I have already mentioned, namely—to catch the insects with trap lights at night, inoculate them with the fungus and set them free in the morning. I hope to be able to devote the greater part of my time during the coming two months to this work.

Mycologist on Sereh Disease at Waterloo.

The Hon. G. T. Fenwick asked the Mycologist whether or not he had heard the rumour that the Sereh Disease was present in Trinidad. The Mycologist replied that he had visited a field of Bourbon cane at Waterloo Estate which was diseased, and had examined the canes. Although on account of the dry weather no cultures of Marasmius were obtained from the roots he thought the trouble was due to the ordinary root disease so common in Bourbon cane. Dr. Gough, however, examined the canes and suggested that Sereh was present and had sent photographs and descriptions to Dr. Went, at Utrecht. In reply Dr. Went did not commit himself but asked that plants be sent to him in a Wardian case so that he might examine the roots himself. [*See* note, p. 246.]

Entomologist's Report.

7. Entomologist's Report.

The Entomologist said:—

I continued my studies of Coconut pests and visited Cedros and Mayaro. Some experimental spraying was done at both places, in connection with ants and scale insects. It was found that lime sulphur wash did not kill the ants, Kerosene emulsion was far more effective. In connection with *Rhina barbirostis* or the Bearded Weevil, I found that eggs were deposited on palms that had been scorched by fire. The trees themselves looked healthy and were bearing well but the scorched bark appears to attract these beetles. As the beetle has to gnaw the bark of the tree to deposit eggs I would recommend that whenever a coconut palm has been scorched, it be sprayed with arsenate of lead. A strong solution should be used, say 5–10 lbs. arsenate of lead to every 50 gallons of water. The practice of firing trees

should not be continued. Flaming trees for ants will do some good, but it should be done with a torch and not by tying dry branches to the trees. No evidences of the Grugru beetle attacking healthy trees were observed.

I paid a visit to Tobago, from the 5th to the 11th instant, and inspected Coconut and Cacao Estates, in the Windward district. On the whole I was impressed by the small number of insect pests to be observed. In the Coconut estates, ants and scale insects were conspicuous by their absence. There were traces of Grugru beetles, but these were secondary pests and had followed trees that were attacked by fungoid disease or were dying from other causes. No Bearded Weevils were observed and Tobago can congratulate itself if they are absent altogether. No *Brassolis* were observed either. As far as Cacao Estates are concerned I did not observe any traces of the Cacao Beetle (*Steirastoma depressum*). Only one species of a tree inhabiting ant (*Azteca*) was found, but it is not numerous. In consequence of this absence of ants there were fewer podhoppers, mealy bugs and other sucking insects to be seen. I would recommend that these ants be sprayed with kerosene emulsion. They appear to have their nests on the immortelle trees in decayed parts of the stem and bark. There were a good many parasol ants in the woods adjoining Cacao Estates. Leaf eating beetles of the cacao were not so numerous as in some parts of Trinidad. Some damage is done to young shoots of cacao; the real culprit was not observed, but it appears to be a beetle (possibly several) which does most damage by eating into and sometimes severing the growing tips of cacao and thus causing a kind of die-back which prevents the proper shaping and growth of a young tree. Spraying with arsenate of lead, would, I am sure, be quite successful to prevent this damage. Many of the cacao planters complained of rats, but I did not have an opportunity of seeing any.

Although the rains set in since the beginning of the month the Froghoppers have not increased materially since last month. The time for starting a campaign with the fungus is now arrived, and if Mr. Rorer and myself can start an epidemic among the Froghoppers, it will certainly do a great deal of good. In Nature the epidemics of fungus appear to occur towards the end of the year when Froghoppers are very numerous and have done damage.

The Assistant Entomologist exhibited a few specimens of Pod-hoppers and cotton insects and said that a report on them would be soon published.

8. Department of Agriculture—Reports by Officers. Reports by Officers—Department of Agriculture.

The Acting Director of Agriculture reported on the Honduras Mahogany seeds which had been received and distributed—also on the prices got for some cotton sold, he also exhibited specimens of the Sea Island and Hybrid cotton from Tobago, and gave information about the lots to be planted at St. Clair and St. Augustine, and also about the seeds received for distribution. Acting Director on Honduras Mahogany seeds, Cotton and Rubber.

He spoke about the rubber stumps to be distributed as per arrangement made by the Rubber Committee; he also exhibited copies of the rubber pamphlet for the London Exhibition issued by the Department.

Mr. de Verteuil on Manurial Experiments.

Mr. de Verteuil reported on the progress of the Manurial Experiments being carried out, and gave some details as to the loss of some cacao trees on Mr. Barnado's estate, from canker.

Mr. Collens on Rubber Experiments.

Mr. Collens reported on the Rubber Tapping Experiments giving details of the yield per tree, showing the decrease when tapped at certain times and exhibited samples of the rubber.

Re 200 tons cold storage space on Royal Mail Company's boats for fruit from Trinidad.

9. C.S.M.P. $\frac{5994/10}{1490}$ Copy of a letter from the General Post Office. London, to the Colonial Office, informing them that the Royal Mail Company had been notified that the amount of Cold Storage space required for the conveyance of fruit from Trinidad to the United Kingdom, would be 200 tons.

Laid on the table.

Secretary of State's approval to Mr. Urich going to Mexico.

10. C.S.M.P. 1816/11. Letter from the Secretary of State for the Colonies approving of Mr. Urich going to Mexico in connection with Froghoppers—for the Tabasco Plantation Company for three months, on no pay.

Laid on the table—Mr. Urich informed the members that he had arranged to leave here on August 1 next.

After thanking the members for their attendance, His Excellency the Governor adjourned the meeting to Friday July 21, 1911.

A. DEVENISH,
Secretary.

At a Meeting of the Board of Agriculture held in the Council Chamber, on Friday, July 21, 1911, at 2.15 p.m.

PRESENT:

His Excellency the Governor (President) *in the Chair*, the Acting Director of Agriculture, the Hons. G. T. Fenwick, C.M.G., and S. Henderson, Lieut.-Colonel J. H. Collens, V.D., Messrs. J. d'Abadie, H. E. Murray, L. de Verteuil, J. P. Bain, J. J. McLeod, J. W. Arbuckle, and Rev. Dr. J. Morton, Messrs. J. B. Rorer (Mycologist), F. W. Urich (Entomologist), P. L. Guppy (Asst. Entomologist), H. A. Caracciolo (Laboratory Assistant), and A. Devenish (Secretary). Messrs. H. S. Shrewsbury, J. McInroy, J. de Verteuil, A. E. Collens and J. C. Augustus of the Department of Agriculture, were also present.

Minutes.

The Minutes of the meeting of June 16 last, having been printed and circulated, were taken as read and confirmed, after the following had been added, at the end of the Mycologist's report:—

Addition to Minutes of June 16.

"The Acting Director of Agriculture stated that Dr. Gough had forwarded confidentially a copy of Dr. Went's letter to the Department of Agriculture and that pending more definite information from Dr. Went, which Dr. Gough was taking steps to obtain, it had been thought advisable to make no public statement on the matter," and in marginal note "*alleged*" to be put in front of sereh.

The following letter was read :—

From the Hon. W. G. Kay regretting being unable to attend on account of pressure of work. Messrs. Kay, Greig and C. de Verteuil unable to attend.

Mr. W. Greig who came up to town, sent to say that having been called on urgent business, he would be unable to attend the meeting.

The Acting Director of Agriculture said that the day before leaving for Europe, the Hon. C. de Verteuil had asked him to inform the members of his departure and asked them to excuse him for not writing as he had been very busy.

The following Financial Statement was submitted :— Financial statement.

RECEIPTS :

Balance on June 16, 1911 ... ...$	9,077 24	
Agricultural Tax for May	2,179 28	
,, ,, June	1,289 02	$ 12,545 54
PAYMENTS :		
Payments to July 21, 1911		1,255 00
Balance in hand		$ 11,290 54

SPECIAL VOTES :

		Expended to June 30.	Balance in hand.
Sugar Cane Experiments (Froghopper)	($3,022)	...$ 1,118 57	$ 1,903 43
Rubber Tapping Experiments	(3,000)	... 1,497 58	1,502 42
Coconut Palm Destruction	(1,000)	... 849 10	150 90
Exhibits at Local Shows	(200)	... 142 83	57 17
Prizes for improved Cacao Cultivation	(960)	... 50 08	909 92
Estates Experiments	(3,720)	... 1,149 41	2,570 59
Permanent Nitrate Committee Expts.	(483)	... 156 37	320 66
Handbook	(456)	... 80 36	375 64
Blocks and Prints for Illustrations	(200)	... 199 50	50
Mosquito Illustrations ...	(120)	... Nil.	120 00
Board of Industrial Training (Farriery Classes for two years).	(240)	... Nil.	240 00
Total ...	$13,401	... $5,243 80	$ 8,151 23*

On the motion of the Rev. Dr. J. Morton seconded by the Hon. S. Henderson, the following recommendation of the River Estate Committee dated July 5, 1911, was adopted :— Recommendation of River estate Committee.

C.S.M.P. 3265/1911—Application from Manager, River Estate, for $4,800—for purchase of Contracts and General Improvements. *Re* purchase of contracts, &c., by River estate.

Recommended that the same be purchased—the trees being first counted and their value assessed by an independent person, in which connection we would suggest Mr. H. Brash of Tucker Valley, should he be willing to act.

The following recommendation of the Advisory Committee dated July 21, 1911, was adopted :— Recommendation of Advisory Committee.

In connection with Mr. Hancock's application for employment as an Inspector, under the Plant Protection Ordinance. Mr. Hancock's application for employment.

Recommended that Mr. Hancock be informed that there is no vacancy at present.

* Included in Balance on hand of $11,290 54 on July 21, 1911.

Messrs. d'Abadie & Seheult appointed to act in place of Messrs. Warner and de Verteuil in Prize Scheme Committee.

Messrs. J. d'Abadie and L. Seheult were appointed to act on the Prize Competition Committee in place of the Hons. R. S. A. Warner and C. de Verteuil, now on leave of absence.

The following papers were submitted :—

Re co-operation by Crown Colonies with African Entomological Research Committee.

1. C.S.M.P. 6002/10. Copy of a despatch from the Secretary of State for the Colonies—and Council Paper No. 82 of 1911, *re* co-operation by the Crown Colonies with the African Entomological Research Committee; also a letter from Mr. Urich, the Entomologist, giving his views as to how the co-operation should be carried out.

   On the motion of the Rev. Dr. J. Morton, seconded by Lieut.-Colonel Collens, it was agreed that the suggestions in Mr. Urich's letter be commended for the favourable consideration of the Government.

West Indian Agricultural Conference to be held in Trinidad in January 1912.

2. Two letters from Dr. Watts, Imperial Commissioner of Agriculture, dated June 23 and July 4, *re* the West Indian Conference to be held in Trinidad, in the last week in January, 1912.

   Referred to the Advisory Committee to appoint delegates to represent the Board.

In connection with pamphlets "Hints to Settlers in Tobago" also Board's handbook.

3. C.S.M.P. 569/09. In connection with the pamphlet "Hints to Settlers in Tobago"—additional issue with alterations required.

   It was decided that the Government be informed that the Board recommends an additional issue as requested. The Handbook now being prepared by the Board will also include Tobago.

Mr. Guppy to draw Entomologist's salary while acting for him.

4. Mr. Guppy's application to draw the Entomologist's salary, instead of his own, while acting for him.

   On the motion of Mr. J. d'Abadie, seconded by the Hon. G. T. Fenwick, the application was agreed to.

Vote of £50 for Rubber Experiments Vote for rubber tapping experiments and training on estates.

5. Request from the Acting Director of Agriculture for a vote of £50 to defray cost of continuing Rubber Tapping Experiments on estates and the training of tappers.

   Agreed to.

Vote of £50 for raising supplies of grafted cacao and mango plants.

6. Request by the Acting Director of Agriculture for a vote of £50 to defray part of expenses in connection with raising supplies of grafted cacao and mango plants.

   The Rev. Dr. J. Morton moved, seconded by Mr. J. P. Bain, that the amount asked for, be granted.

   The Hon. G. T. Fenwick, seconded by the Hon. S. Henderson, moved the following amendment, that the words "*and mango plants*" be left out.

   On being put to the vote the amendment was lost.

At 4.15 all the country members had to leave for the train; there being no longer a quorum, His Excellency the Governor adjourned the meeting to Friday, August 18, 1911.

A. DEVENISH,
Secretary.

At a Meeting of the Board of Agriculture held in the Council Chamber on Friday August 18, 1911, at 2.15 p.m.

PRESENT:

His Excellency the Governor (President) *in the Chair*, the Acting Director of Agriculture, the Hons. G. T. Fenwick, C.M.G., and W. G. Kay, Lieut.-Colonel J. H. Collens, V. D., Messrs J. Moodie, H. E. Murray, L. de Verteuil, J. P. Bain, Louis Seheult, B.Sc., Thos. Thornton, J. W. Arbuckle, J. B. Rorer (Mycologist), P. L. Guppy (Actg. Entomologist), H. A. Caracciolo (Laboratory Assistant), D. C. Plummer (Agric. Inspector), L. A. Brunton (Agric. Inspector), and A. Devenish (Secretary.) Messrs. Shrewsbury, de Verteuil and Collens of the Department of Agriculture, were also present.

The Minutes of the meeting of July 21, last, having been printed and circulated, were taken as read and confirmed. Minutes.

The following letters were read :—

(1.) From Mr. Wm. Greig, dated July 23, 1911, applying for leave of absence from July 25 to August 29. Letters from Mr. Greig for leave of absence.

This application was granted.

(2.) From Rev. Dr. J. Morton, dated August 17, 1911, regretting his inability to attend the meeting. Rev. Dr. Morton unable to attend.

The following Financial Statement was submitted :— Financial statement.

RECEIPTS :	
Balance on July 21, 1911	$11,290 54
PAYMENTS :	
Payments to August 18, 1911	1,193 00
Balance in hand	$10,097 54

SPECIAL VOTES :

	Amount of Vote.	*Expended to July 31.*	*Balance in hand.*
Sugar Cane Experiments (Froghopper) ...	$3,022	$1,208 34	$1,813 66
Rubber Tapping Experiments	3,000	1,497 58	1,502 42
Coconut Palm Destruction	1,000	849 10	150 90
Exhibits at Local Shows	200	142 83	57 17
Prizes for improved Cacao Cultivation ...	960	50 08	909 92
Estates Experiments	3,720	1,179 41	2,540 59
Permanent Nitrate Committee Experiments ...	483	156 37	320 66
Handbook	456	92 34	363 66
Blocks and Prints for Illustrations	200	199 50	50
Mosquito Illustrations	120	Nil.	120 00
Board of Ind. Train. (Farriery classes for 2 yrs.)	240	120 00	120 00
For Grafted Cacao and Mango plants ...	240	Nil.	240 00
	$13,641	$5,495 55	$8,139 48*

* Included in Balance on hand of $10,097 54 on August 18, 1911.

Report of Prize Competition Committee.

The following report of the Prize Competition Committee, dated August 4, 1911, was adopted :—

CACAO.

A meeting of the Prize Competition Committee was held at the Red House, on August 4, to discuss the questions of the appointment of Judges and the mode of judging; present: Mr. W. G. Freeman (Acting Vice-President) Mr. J. d'Abadie and Mr. L. Seheult.

In view of the facts that the competitors are numerous and scattered over a wide area, approximately 300 in the Arima and Manzanilla Ward Unions (Centre A) and 128 in the Brasso, Couva and Chaguanas Ward Unions (Centre B) the Committee makes the following proposals :—

(1.) That each Inspector visits, by October 31, all cultivations in his district, (*see* Agricultural Inspector's Report, Centre A dated July 17, 1911.) and selects the best for the final judging.

(2.) That the judging of the cultivations so selected be done by three judges, the two Inspectors, and one Proprietor from each centre, to act in that centre, with, for each centre, two members of the Board of Agriculture, who should act with the previous three when requested in any cases of difficulty.

(3.) That the Judges might be :—

Centre A.	Centre B.
The Agricultural Inspectors.	The Agricultural Inspectors.
Mr. Gaston de Verteuil.	Mr. A. B. Carr.
(Mr. L. Seheult.)	(Hon. Carl de Verteuil.)
(Mr. J. H. Wade.)	(Mr. J. d'Abadie.)

Members of the Board of Agriculture as reserve.

(4.) That the expenses of the additional travelling by the Agricultural Inspectors be defrayed, and that the other Judges be given an honorarium of $10 per day to include their travelling expenses.

(5.) That the jugding be commenced early in November and completed during that month.

The following papers were submitted :—

Acting Director of Agriculture's invitation to members at Rubber demonstration at St. Clair.

1. Letter from the Acting Director of Agriculture inviting the members of the Board to a rubber demonstration at St. Clair, at the end of September or early in October.

His Excellency the Governor, in the name of all, thanked the Acting Director for his kind invitation and said that he was sure the members would gladly attend.

Importation of Para rubber seeds from Ceylon and Singapore.

2. Proposal by the Acting Director of Agriculture that 75,000 Para rubber seeds be imported by parcel post from Ceylon and 75,000 from Singapore, and that the Government be asked to meet the expenses by granting an advance of £150 or taking a vote for this amount, whichever may be the proper course.

On the motion of the Acting Director of Agriculture seconded by the Hon. G. T. Fenwick and agreed to, it was decided that the Government be recommended to import the seeds.

3. On the motion of the Hon. G. T. Fenwick seconded by Mr. H. E. Murray and agreed to, it was decided that the Government be asked to issue a proclamation prohibiting the importation of Rubber stumps, also prohibiting the importation of seeds from Suriname and Demerara, and that all imported rubber seeds be disinfected by an officer of the Department of Agriculture or Board of Agriculture. Proclamation *re* importation of Rubber stumps and seeds.

4. C.S.M.P. 6702/08—Engagement of experienced Entomologist to investigate Froghopper. *Re* contribution by the Board towards the expenses of the visit of Dr. Gough. Engagement of experienced Entomologist by Sugar Planters for Froghopper.

   Referred to the Advisory Committee.

5. Letter from the Mycologist—*Re* Spraying Outfit. Spraying Outfit.

   On the motion of Mr. H. E. Murray seconded by Mr. Thornton and agreed to, it was decided that a Spraying Outfit—at a cost not exceeding $350—be imported.

6. Letter from the Mycologist—*Re* publication of a circular on snakes of Trinidad. Circular on snakes, &c.

   Agreed to.

7. C.S.M.P. $\frac{2469/11}{1982}$. (Council Paper 99/11.) Summary of Revenue and Expenditure of the St. Augustine Estate for the year ended March 31, 1911. Statement of Revenue and Expenditure, St. Augustine Estate to March 31, 1911.

   Having been circulated, it was laid on the table.

8. Mycologist's application for an extra vote of $200 towards exhibits at Local Shows. Extra vote of $200 for Exhibits at Local Shows.

   Referred to the Advisory Committee.

9. Standardization of Cacao—Books received from Canada, on Standardization of different products. Standardization of Cacao—Books from Canada.

   Postponed.

10. Department of Agriculture—Reports by Officers.

Since the June meeting of the Board I have been able to visit some parts of the Colony; the Usine, Ste. Madeleine (twice) including San Fernando and Princes Town and neighbourhood, Verdant Vale, Brechin Castle, Waterloo Cacao Estate, Suconusco, Mon Valmont and La Chance, as well as the estates of the Department. My thanks are due to those who have kindly offered me facilities for becoming acquainted with the agriculture of the island. Acting Director of Agriculture's Report.

Rubber.—At Verdant Vale the various rubber trees compare very favourably with those I have seen in Ceylon and West Africa. With the kind co-operation of Mr. F. Seheult at Verdant Vale and Mr. Greig at Cedros, I hope soon to be able to arrange for a regular series of tapping experiments on Funtumia, the records of which, in Trinidad, are very scanty at present.

About 1,000 Para rubber stumps, raised from imported Malayan seeds, have been distributed free (in accordance with the decision of the Rubber Committee) in lots of 40 to selected localities, the Department to have a claim on 50 per cent. of their seed at any time.

Rubber tapping is in regular progress at St. Clair and Government House Gardens. A notice kindly published by the Press brought a good many visitors, but as the usual time was not convenient to country members a demonstration of the methods of tapping and preparing rubber, for members of the Agricultural Society, was arranged for August 11, at 9.30 a.m. and was attended by His Excellency the President and some 50 members and their friends.

The Trinidad and Tobago exhibits have been well reported on at the Rubber Exhibition and the Cup awarded to the Department for the best specimen of rubber from any West Indian Botanic Station has arrived and is on the table. Mr. Collens and Mr. Broadway are to be congratulated on the success which has attended their work.

Grafted Cacao and Mango.—The advertisement placed in the papers has doubtless come to the notice of every one here. A useful amount of instruction in grafting will be given as a result and the work is already being pushed forward.

St. Augustine Estate and Government Farm.—The banana plots have been greatly improved since the rains and there is at present very little sign of disease.

Through the kindness of the British West Indian Fruit Co., reports are received regularly by the Department on the condition, etc., of fruit shipped from Trinidad. The reports on recent arrivals at Southampton are here for the information of members. They indicate that the fruit was suffering from the long drought, but nevertheless fair prices were obtained and future prospects are reported as good.

During this season the following new plots have been or are being laid out in accordance with plans drawn up by Professor Carmody.

	Approximate area.
No. 1 Para Rubber	1 acre.
,, 2 Para Rubber and Cacao	1 ,,
,, 3 Grafted Cacao with shade	1 ,,
,, 4 Cacao without shade	1 ,,
,, 5 Camphor	$1\frac{1}{5}$,,
,, 6 Rio Negro Para Rubber	$\frac{1}{3}$,,
,, 7 Soya Beans, 5 Varieties	$\frac{1}{2}$,,
,, 8 Alfalfa	$\frac{1}{4}$,,
,, 9 Corn from United States of America, 5 Varieties	1 ,,
,, 10 Thornton's Hybrid Cotton	1 ,,
,, 11 Yams, 5 Varieties from Barbados... ...	$\frac{1}{2}$,,
,, 12 Seedling and other Canes 28 Varieties ...	$3\frac{3}{4}$,,
,, 13 Tobacco	1 ,,
,, 14 Sweet Potatoes	

Mr. McInroy who is giving a great deal of attention to this work reports that the plots already occupied are all in good condition.

Small plots of most of these plants have been also set out at St. Clair and Government House Gardens for easy inspection of those interested.

RIVER ESTATE.—Three new experimental plots have been arranged to test the value of Ohlendorf's Cacao Manure and other work carried on as usual.

COTTON.—A small plot of Thornton's Hybrid cotton was grown last season at St. Augustine. Professor Carmody took samples to England with him and since has forwarded the following reports :—

BRITISH COTTON GROWING ASSOCIATION :

"If better ginned, value 15½d. Sea Island character, rather badly "ginned, staple fine, strong, but irregular in length."

I may say we are aware that the cotton was not ginned well, but the machine at St. Clair had not been used for a long while and a part was damaged.

CARAVONICA COTTON GROWERS :

" A most excellent Cotton, in every respect equal to best Sea Island. There may be some Sea Island Cotton which is somewhat more silky, but the cotton of this sample possesses more strength, which more than makes up for the somewhat less silky nature." The defects in ginning are noticed and the report concludes. "The price should be the same as for best Sea Island, viz.: (to-day July 14th) in Liverpool for medium quality 14½ to 16d. for extra quality 15½ to 20d. per lb. . . . . To my mind the report on your Hybrid Cotton is eminently favourable and should encourage you to proceed on the lines so far followed by you in breeding this new Hybrid Cotton."

In Trinidad the Department has distributed to 17 growers seeds supplied by Mr. Thornton sufficient to plant 64 acres, and about 150 acres are under this crop in Tobago—some 60 to applicants at the Botanic Station.

PUBLICATIONS.—The following publications have recently been issued:—

(1.) "Notice to Cotton Growers in Tobago."
(2.) "Quarterly Calendar of work on Cacao Plantations" by Mr. Brunton.
(3.) " Crop Record Card for Cacao."
(4.) Bulletin of the Department for June.
(5.) "Courses of Reading—Practical Agriculture" (Revised Edition).
(6.) Circular No. 11—"Short hints on Cacao cultivation for Peasant Proprietors," by Mr. Plummer.
(7.) Circular No. 12—"Notes on the good cultivation of Cacao" by Mr. J. C. Augustus.

A box of cigars from Tobago, brought over by Mr. Thornton was also exhibited.

(Sgd.) W. G. FREEMAN.

In March an investigation was commenced (with the co-operation of Mr. J. McInroy) of the quantity and quality of the milk yielded by the cows on the Government Farm. The yield given by each animal was measured and a fair sample of its milk sent to the Laboratory in order that its quality might be valued by analysis. Mr. Shrewsbury's Report.

65 cows have been examined up to date, including:—40 half-bred Zebus, 13 half-bred Red Polls, 8 half-bred Guernseys, 2 half-bred Short Horns, 1 Holstein and 1 Guernsey.

The cows which gave more than 5 quarts of milk were classed as "very good" and further sub-divided into 4 classes according to the *quality* of milk given.

These classes were:—

"Very Good," per cent. of fat of 3·5 or more.

"Good," fat of 3 and upwards but less than 3·5.

"Poor," fat of 2 and upwards but less than 3·0.

"Very Poor," less than 2·0.

The comparison was favourable to the half-bred Zebus. They showed 27½ per cent. of "good" and "very good" cows as compared with 25 per cent. and 23 per cent. for half-bred Guernseys and half-bred Red Polls respectively.

Amongst the half-bred Zebus there is the best cow of the 65, giving the largest quantity and the best quality of milk. The figures of this milk were:—Total solids 14·1 per cent.; solids not fat 8·9 per cent.; fat 5·2 per cent. which is well above the Government Standards of the United Kingdom and Trinidad.

In this class there is also the cow which gives the best figures for quality, namely:—Total solids 14·3 per cent.; solids not fat 8·1 per cent.; fat 6·2 per cent.

It would appear possible to obtain very fine cows by selective breeding from this class.

The Guernsey cow gave milk of almost the same quality as the best of the Half-bred Guernseys, and the yields given by these cows were identical.

The Half-bred Short Horns were classed as "Very Good" both in quantity and quality of milk.

The Holstein gave "good" quality of milk. The quantity yielded was poor, but the cow is young and will no doubt give larger quantities of milk later.

I hope shortly to publish a full account of this investigation in the Departmental *Bulletin.* [*See* pp. 220-24.]

(Sgd.) HERBERT S. SHREWSBURY.

Mr. de Verteuil's Report.

At the end of June I happened to be in the Talparo district and took the opportunity of inspecting the plots on the Perseverance Estate. Everything was found to be in order, but owing to the two control plots being very close to one another, it has been thought advisable to add an extra control plot.

On August 2, I inspected the cane plots at Malgretout and the cacao plots at New Grant.

The canes are looking exceedingly well. On three of the plots the manures were applied too liberally, so that the entire plot was not manured. This, however, in no way detracts from the value of the experiments, as instead of the plots being an acre each, they will now be $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$ of an acre respectively.

The cacao plots at New Grant presented a healthy appearance, there were a few fruit of all sizes and a good show of small chireros.

No pen manure has been applied to plots 6 and 12 as originally intended.

The cane and cacao plots at Esperanza were inspected last week.

The canes are healthy but backward. Cacao pickings will be late.

It has been suggested to me to have printed forms for sending in the returns of the cacao pickings, and I beg to have your sanction to have the necessary forms printed not only for cacao, but for coconuts also.

(Sgd.) JOSEPH DE VERTEUIL.

Mr. Collens' Report.

I have the honour to report with regard to the rubber industry, that a series of experimental tappings was commenced on Hevea trees at the Experiment Station, St. Clair, on Monday July 3, at 8 o'clock. Due announcement was made in the daily papers, and several gentlemen interested in rubber were present. Quite recently (August 11) a demonstration in tapping and in preparing Hevea rubber was given to the members of the Agricultural Society and was well attended. The trees have been divided into the following blocks :—

1st Division—Fair yielders.

Trees Nos. 1, 2, 3, 6. These were tapped on the full herring-bone system on one half their circumference from September 12, 1910, to February 28, 1911, during which period they yielded respectively 54·5, 53·8, 53·8, and 22·7 ounces. They are all yielding a fair amount of latex, No. 6 however still continues to yield less than the others.

2nd Division—Poor yielders

Trees Nos. 4, 5, 7, 8. Tapped as above, but poor yielders, the latex is yellowish in colour and the rubber not so tough or resilient as the rest. Nos. 4 and 5 yielded respectively 14·3 and 8 ounces during the period September 12 to December 31, 1910, after which they ceased to flow. No. 5 tree has given a very small amount of latex for the half month of July.

3rd Division—Trees Nos. 12 and 13 in Govt. House Valley.

Two large Hevea trees in the Valley in the back of Government House grounds. Age estimated at 30 years. The measurements are as follows :—

	No. 12.	*No. 13.*
Girth at one foot from ground...	54 in.	64 in.
Girth at six feet from ground ...	44 „	51 „

These were both tapped on opposite quarters with five half herring-bone cuts.

Tapping was started on February 13, 1911, but had to be discontinued on March 13, as the trees had dropped their leaves and were seeding. Both trees are heavy yielders, the latex containing 50 to 70 per cent. of dry rubber, as compared with 35 to 45 per cent. of rubber found in the younger

trees at St. Clair. During the period above mentioned the yield from the two trees combined was six pounds of cured rubber. They continue to yield a good flow of latex.

4th Division—Newly tapped trees at St. Clair—Trees Nos. 14 to 19.

Six trees tapped on half herring bone system over one-fourth the girth of the tree for comparison with Nos. 20 to 25, which are being tapped on the double herring bone system over the same area. The trees are yielding fairly well, one (No. 18) is conspicuous for its high yield, giving 21·14 ounces of dry rubber during the month of July. As this tree, in distinction to the others, is producing a large crop of seeds, this high yield is very interesting and instructions have been issued to keep the latex separate from that of the other trees, so that a special record may be kept of its yield and the quality of the rubber investigated later on.

5th Division—Newly tapped trees at St. Clair.

Trees Nos. 20 to 25. Same size as preceding trees, but tapped on double herring bone system over one-fourth of the girth of each tree. All the trees are yielding fairly well. No. 21 however is a good deal behind the others.

These trees are been tapped on every alternate day, allowing one day's rest between each tapping.

The registered yields in latex and dry rubber for the month of July are as follows :—

YIELDS JULY 3 TO 31.

	Latex c.c.	*Dry Rubber ounces.*		*Latex c.c.*	*Dry Rubber ounces.*
1	869	9·97	15	1061	14·41
2	748	6·33	16	385	5·08
3	498	11·05	17	390	5·16
4	129	1·69	18	1916	21·14
5	34	0·44	19	566	7·48
6	379	4·82	20	450	6·04
7	287	3·77	21	212	2·84
8	421	5·53	22	747	10·02
12	2705	34·47	23	518	6·95
13	2231	28·82	24	504	6·76
14	576	7·56	25	499	6·70

Young Hevea experiments at Sangre Grande

The tapping experiments on the hundred three and a half years old trees at Non Pareil Estate, Sangre Grande, having been discontinued as it was found that the trees were dropping their seeds. Three pounds six ounces dry rubber were obtained from sixteen tappings or slightly over half an ounce per tree. The system adopted was one V or double herring-bone covering half the girth of the tree, and Messrs. Lewis and Peat of Mincing Lane, who examined the West Indian exhibits at the recent International Rubber Exhibition, reported as follows on these biscuits :—"Fine, well prepared, smoked Hevea biscuits, in excellent condition. . . . . These biscuits show little room for improvement. . . . . ."

In company with the Acting Director I visited Verdant Vale Estate, Arima where five trees were tapped. These trees had been tapped previously on November 2 and 17, 1910. The results are as follows:—

Tree No.	*Approx. Age.*		*Girth Nov. 2, 1910. inches.*		*Girth July, 1911. inches.*		*Increase in 8 months.*
H.	8 years	...	43	...	48	...	5
J.	12 ,,	...	72	...	76	...	4
K.	10 ,,	...	48	...	50	...	2
L.	8 ,,	...	39	...	42	...	3
M.	8 ,,	...	35	...	38	...	3

YIELD IN CUBIC CENTIMETRES.

Tree No.	*Nov. 2, 1910.*		*Nov. 17, 1910.*		*July, 1911.*
H.	560 c.c.	...	430 c.c.	...	* 56 c.c.
J.	750 ,,	...	430 ,,	...	1,020 ,,
K.	250 ,,	...	160 ,,	...	510 ,,
L.	100 ,,	...	35 ,,	...	113 ,,
M.	100 ,,	...	70 ,,	...	170 ,,

I take great pleasure in reporting that the rubber exhibits in general from Trinidad and Tobago have been most favourably commented upon and especially the Castilloa exhibits from Caledonia and Easterfield, Tobago, the brokers reporting that "they were better than anything we have seen either from Mexico or anywhere else." In a recent letter Professor Carmody states: "I am glad to say that all our samples received great attention. . . . . the samples of rubber prepared by the frame method attracted very favourable notice at the Exhibition and they and others have surprised many persons that Castilloa could be so prepared so accustomed have they been to its black sticky appearance."

(Sgd.) A. E. COLLENS.

11. Mycologist's Report:— Mycologist's Report.

The greater part of my time during the past month has been spent on the froghopper problem. The experiments which have been made with the fungus so far show that the insects can be artificially inoculated with the fungus in the field, and that they contract and spread the disease. Both methods which have been tried have proved successful in inoculating the insects. However the disease has not spread as rapidly as I thought it would, and from observations which I have made I think some other method of inoculating the insects will have to be resorted to. I am still of the opinion that the fungus should be grown in large quantities in cabinets similar to the one which I had made and tried last year, so that spores could be obtained in large quantities and distributed broadcast with the dusting machine over the fields. On account of lack of room in our laboratory in the Gardens I have been unable to grow fungus in any great quantities.

* Tree diseased, canker entered through some previous tapping. On chiselling the cankered area a large amount of greenish liquid spurted out.

Blight has already appeared in one or two fields in some places and from a study of these fields it seems very clear that the blight is caused by nymphs hatched from eggs laid at the beginning of the rainy season. The field which shows the blight most distinctly is one of plant canes adjacent to a field which was badly blighted last year and which has been turned out this year. The eggs which were laid in the cane trash late last year remained on the ground with the trash after cutting, and hatched at the beginning of this rainy season. Insects from these eggs have laid the eggs from which the nymphs have come and are causing the present outbreak of blight in the plant canes.

The cacao spraying experiments will be taken up again shortly,—I have already reported results of this work for the first half year. Spraying will be begun again within the next month as the trees are just beginning to put out the crops.

I have also continued my work on the Panama disease of banana.

Entomologist's Report.

12. Acting Entomologist's Report :—

Adult froghoppers were numerous early in July, these were doubtless from eggs that had aestivated, or lain dormant, during the dry season.

The dry season this year broke up very gradually and it was well into June before really heavy showers began and conditions became suitable for egg-hatching.

Early this month I noticed a great falling off in numbers of adults, but freshly laid eggs and nymphs were found in great numbers, a large proportion of the latter were first and second stage nymphs.

At *this season* I would strongly recommend crushing the young nymphs wherever spittle is plentiful, this can be done at the same time that the canes are weeded and trashed.

It has been stated that froghoppers re-appeared in the same field that had been trashed the previous year, and that the attack was as bad as if no such preventive measures had been taken. The development of a migratory instinct in the froghopper seems to have been overlooked! This would easily account for the re-appearance of froghoppers in the same field: a field could be re-infected from any part of the same estate, especially from any abandoned cultivation.

The development of the migratory instinct at certain seasons is well known to occur in many orders of insects.

Gough says "occasionally of course a female wanders, and if carried by the wind may go to some distance and start a new centre of infection," there is no reason why this "wandering" should not be done on a larger scale, and assume considerable proportions at suitable seasons, even though the females as a rule are of sedentary habits.

Cotton stainers (*Dysdercus howardi* and *D. howardi* var *minor*) together with Cacao podhoppers and miscellaneous insect pests have been very plentiful this season. There has not been much cotton planted yet in Trinidad, but the small quantity of Thornton's hybrid grown this year shows to great advantage and I believe the results of the pickings are very good in spite of the stainer. Various experiments are now being undertaken with a view of finding some means of more effectually controlling this pest.

13. A letter to the Acting Director from Mr. Plummer in connection with an article in the *Port-of-Spain Gazette* on Mr. Plummer's "Short hints for Peasant proprietors" was read. Article in *Port-of-Spain Gazette* on Mr. Plummer's Short hints to Peasant Proprietors.

14. C.S.M.P. $\frac{1130/11}{2092.}$ Committee to be asked to report on certain matters affecting the Government Stock Farm, Tobago. Stock Farm Tobago.

Laid on the table.

After thanking the members for their attendance, His Excellency the Governor adjourned the meeting to Friday, September 15, 1911.

A. DEVENISH,
Secretary.

Section XVI.—Meteorological.

RAINFALL—Return for 9 months ending September, 1911.

Station	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total	Total for corresponding period 1910.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
North West District.											
St. Clair—Royal Botanic Gardens ...	1·61	1·51	1·86	·74	1·27	7·15	5·20	13·68	4·03	37·05	48·59
Port-of-Spain—Colonial Hospital ...	1·37	·68	1·84	·62	1·57	6·30	2·39	10·70	3·20	28·67	38·85
,, Royal Gaol ...	1·52	1·79	2·10	·63	1·61	7·36	3·60	11·36	4·50	34·47	45·65
,, Constabulary Head-quarters ...	1·48	1·74	3·02	·78	·54	5·93	5·23	11·62	3·50	33·84	44·91
St. Ann's—Reservoir	1·90	1·79	2·25	1·25	1·82	7·05	4·68	18·00	3·20	41·94	57·76
Maraval—Reservoir	2·27	1·85	3·10	1·72	1·79	7·36	6·05	17·08	5·34	46·56	65·04
,, Constabulary Station ...	2·85	1·82	4·26	1·14	1·52	7·55	6·32	18·56	6·06	50·08	67·18
Diego Martin ,, ,, ...	1·43	3·67	2·73	2·24	·98	11·03	8·19	17·86	6·64	54·77	58·09
,, ,, Water Works ...	2·36	3·25	2·01	1·65	·64	9·85	8·17	16·32	6·55	50·80	57·79
,, ,, River Estate ...	2·00	2·98	1·92	1·08	·55	10·83	8·17	15·35	7·09	49·97	58·40
Fort George Signal Station ...	2·59	1·82	2·55	1·27	1·33	7·33	4·79	13·46	3·01	38·15	51·41
North Post ,, ...	1·82	2·66	1·66	·66	·78	6·97	7·29	14·17	4·95	40·96	54·25
Carenage Constabulary Station ...	2·30	2·35	2·06	2·15	2·45	12·44	6·86	21·03	4·56	56·20	55·62
Carrera Island Convict Depôt ...	1·75	2·77	1·71	·48	1·80	8·86	4·62	8·15	3·26	33·40	43·05
Chacachacare Light House ...	2·17	2·05	2·69	3·13	2·40	7·20	8·54	3·41	3·43	35·02	45.73
Santa Cruz—Maracas District.											
Santa Cruz Constabulary Station ...	2·69	1·90	3·82	2·02	1·76	9·74	6·94	15·43	2·84	47·14	64·01
St. Joseph ,, ,, ...	1·72	1·23	·89	1·21	·64	9·49	3·05	13·35	2·62	34·20	42·94
Government Farm, St. Joseph ...	3·01	1·97	1·62	2·00	1·14	8·90	2·97	14·38	3·98	39 97	49·88
St. Augustine Estate, Tunapuna ...	·92	1·18	·61	2·38	1·27	8·35	2·86	15·73	4·04	37·34	62·66
Maracas—Ortinola Estate ...	4·37	1·85	4·12	1·13	1·76	6·04	3·55	10·70	1·88	35·40	59·39
,, Government School ...	3·74	1·41	3·66	1·10	1·93	7·75	5·17	9·98	1·94	36·68	60·28
West Central District.											
Caroni, Frederick Estate	2·89	3·87	2·28	5·23	2·16	17·78	8·05	15·99	5·87	64·12	94·76
Chaguanas, Constabulary Station ...	1·85	2·34	·47	1·49	·91	12·62	5·05	11·52	4·82	41·07	58·41

RAINFALL.—Return for 9 months ending September, 1911.—CONTINUED.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total.	Total for corresponding period 1910.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	ns.	Ins.
West Central District.—Contd.											
Chaguanas, Woodford Lodge Factory ...	2·43	2·18	·40	1·70	1·23	11·78	5·06	10·84	4·63	40·25	55·29
Carapichaima, Waterloo Estate ...	2·15	2·01	2·36	1·89	2·24	15·68	5·32	14·78	5·12	51·55	61.51
,, Friendship Hall Estate...	...	...	·35	2·05	·80	15·15	5·10	13·75	4·20	41·40	*
Couva, Constabulary Station ...	1·16	1·83	·81	1·59	1·74	11·87	4·51	15·01	5·47	43·99	—
,, Exchange Estate ...	·68	1·42	·83	·93	1·09	11·72	4·78	12·43	4·16	38·04	45·00
,, Perseverance ,, ...	1·45	1·77	1·21	·91	2·35	13·69	5·30	13·91	4·37	44·96	53·59
,, Camden ,, ...	·96	1·67	·37	1·46	1·33	11·01	5·27	13·93	4·79	40·79	37·37
,, Milton ,, ...	1·28	1·34	1·66	2·77	·43	15·05	6·82	15·70	4·52	49·57	50·25
,, Spring ,, ...	1·05	1·72	·90	4·07	·74	14·93	5·42	13·94	3·54	46·31	58·17
,, Brechin Castle ,, ...	1·39	1·78	·93	1·24	1·71	14·62	6·14	13·95	4·53	46·29	53·92
,, Esperanza Estate, Savonetta ...	·52	1·69	1·00	1·32	1·15	13·50	6·48	9·22	3·55	38·43	46·56
San Fernando & Princes Town District.											
Claxton's Bay, Forres Park Estate ...	68	2·35	·18	2·82	1·33	15·19	6·16	11·56	3·71	43·98	42·21
Pointe-à-Pierre, Bonne Aventure Est...	1 59	1·55	1·26	2·62	1·28	14·65	6·90	9·81	8·32	47·98	51·93
,, ,, Concord Estate ...	1·44	1·96	·91	2·33	1·07	18·64	7·11	11·87	9·77	55·10	56·40
,, ,, Plein Palais Estate ...	1·13	1·74	1·01	1·86	·36	17·38	4·81	10·94	8·55	47·78	51·26
Naparima, Picton Estate	·94	1·77	1·20	1·74	1·85	11·82	4·83	8·36	3·63	36·14	49·89
,, Usine Ste. Madeleine Est....	1·49	1·78	2·61	2·31	1·85	20·75	4·69	10·69	6·20	52·37	59·11
,, Union Hall Estate ...	·78	1.62	1·69	1·22	2·05	18·38	4·33	8·75	4·28	43·10	58·63
,, La Fortunée Estate ...	·69	1 71	·91	1·17	1·00	15·53	4·50	7·65	3·01	36·17	53·47
,, Craignish ,, ...	1·66	1·42	·65	1·03	·85	17·78	5·03	6·71	2·09	37·22	52·87
,, Lewisville ,, ...	1.68	1·96	2·01	2·29	1·33	21·97	6·96	12·63	7·88	58·71	62·08
,, Tarouba ,, ...	·90	1·72	2·21	1·97	1·01	14·95	3·55	8·30	5·78	40·39	52·45
,, Palmiste ,, ...	·61	1·87	1·67	1·93	1·80	17·39	4·79	8·57	4·08	42 71	—
Princes Town, Cedar Hill Estate ...	·74	1·72	·26	1·92	2·24	15·89	4·83	10·72	3·57	41·89	62·60
,, ,, Constabulary Station ...	1·46	2·37	1·71	1·40	2·18	18·37	8·11	7·75	2·31	45·66	62·12
,, ,, Williamsville Estate ...	1.52	1·50	1·75	1·12	1·98	18·20	2·05	8·89	3·00	40·01	61·82

* Stations from which no records were received previous to 1911.

RAINFALL.—Return for 9 months ending September, 1911.—CONTINUED.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total.	Total for corresponding period 1910.
San Fernando & Princes Town District.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
New Grant Estate, Savana Grande ...	2·84	2·40	2·05	2·58	1·65	19·69	6·54	8 71	1·57	48·03	46·69
Malgretoute ,, ,, ,, ...	·91	1·45	1·93	1·66	1·77	18·09	4·56	6·99	2·36	39·72	55·26
Friendship & Ben Lomond Ests., Sav. Gde	·39	·96	·58	1·42	1·15	19·15	...	5·75	3·34	32·74	54·30
El Rosario Estate, Poole	3·66	3·33	2·06	2·43	4·44	21·48	9·03	15·00	3·78	65·21	81·31
Montserrat District.											
Constabulary Station, Montserrat ...	1·48	2·60	·65	3·82	1·57	16·23	10·38	8·52	2·48	47·73	60·82
Brasso, La Vega Estate	3·57	3·56	·71	2·88	1·65	16·76	7·35	14·00	4·26	54·24	67·78
Arima District.											
Arima, Torrecilla Estate	2·53	3·14	1·02	3·77	5·63	20·44	6·22	16·31	3·03	62·09	66·93
Arima, Verdant Vale Estate ...	3·99	5·06	1·32	2·62	3·92	15·23	5·33	11·99	2·38	51·84	83·45
Warden's Office, Arima	1·07	1·02	·38	2·65	3·54	12·37	1·32	6·83	2·94	32·12	40·45
San Rafael, Constabulary Station ...	3·13	3·67	1·28	2·31	4·23	20·58	6·68	13·94	3·32	59·14	82·73
Guanapo, Talparo Estate	3·02	3·26	·80	2·46	4·29	15·74	7·62	11·72	3·19	52·10	85·87
Santa Mata Estate, Tamana ...	...	...	...	3·56	5·25	16·95	9·29	17·38	5·19	57·62	*
South-West District.											
Oropuche, Pluck Estate	·92	1·97	·98	3·19	1·92	11·82	6·97	9·81	5·02	42·60	54·92
,, Constabulary Station ...	1·05	1·93	·46	2·61	1·99	13·62	6·51	11·47	3·84	43·48	55·12
Siparia, ,, ,, ...	1·65	2·53	1·30	1·46	1·21	18·70	7·51	13·64	4·37	52·37	79·42
Cedros, ,, ,, ...	3·48	1·46	4·84	·95	1·78	8·67	4·67	8·68	1·81	36·34	57·11
Cap-de-Ville. ,, ,, ...	3·09	2·24	4·79	2·77	5·43	12·95	7·34	14·42	4·39	57·92	68·58
Guapo, Adventure Estate ...	1·37	1·99	3·69	2·55	2·04	10·52	6·74	9·56	2·25	40·71	52·91
Icacos, Constance ,, ...	6·05	1·90	4·05	1·35	1·45	10·05	7·60	14·99	2·55	49·90	144·35
Erin, La Resource ,, ...	1·23	4·55	3·74	1·34	·50	13·77	4·31	8·40	3·47	41·31	56·92

* Stations from which no records were received previous to 1911.

RAINFALL.—Return for 9 months ending September, 1911.—CONTINUED.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total.	Total for corresponding period 1910.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
North Coast.											
Blanchisseuse, Constabulary Station ...	7·04	4·92	5·44	2·34	1·45	16·37	7·91	11·75	2·06	59·28	97·82
Grande Rivière, Mon Plaisir Estate ...	4·16	9·25	5·43	4·60	6·48	21·66	8·39	14·22	3·85	78·04	78·18
Toco, Aragua House	5·35	7·43	2·69	2·56	5·91	20·42	5·99	9·25	5·18	64·78	61·41
,, Constabulary Station ...	3·80	5·99	2·16	2·77	5·62	18·04	5·32	7·74	2·55	53·99	60·00
Pointe Galera, Light House ...	·30	3·22	·33	·78	1·42	10·48	1·17	4·69	·60	25·99	49·97
East Coast.											
Mayaro, Constabulary Station ...	4·41	3·58	1·62	2·58	4·26	15·83	6·33	12·89	2·94	54·44	25·91
Manzanilla, Constabulary Station ...	4·32	4·48	1·99	3·51	2·81	17·27	5·61	19·04	2·98	62·01	97·78
Matura, La Juanita Estate... ...	4·95	5·11	2·41	3·45	7·53	19·12	7·14	12·97	3·25	65·93	84·61
Sangre Grande, Sta. Estella Estate ...	4·38	5·24	2·67	2·60	4·53	18·64	7·01	18·04	3·36	66·47	94·58
,, New Lands ...	5·07	5·38	1·80	·87	6·08	15·06	9·25	11·81	3·80	59·12	*
,, Evasdale Estate ...	...	5·21	1·53	3·83	4·22	18·73	8·27	18·10	4·58	64·47	*
,, Grosvenor Estate ...	...	...	...	3·66	4·94	18·57	7·53	14·76	3·91	53·37	*
South Coast.											
Moruga, Constabulary Station ...	2·68	1·85	1·25	2·13	2·77	16·63	4·92	7·41	2·76	42·40	21·46
Tobago.											
Tobago, Botanic Station	2·63	2·73	1·56	3·25	1·56	18·75	7·68	8·52	4·23	50·91	49·97
,, Hermitage Estate ...	3·22	9·15	2·96	5·81	7·10	21·76	8·01	13·78	7·94	79·73	73·55
,, Riversdale ,, ...	3·80	4·34	1·36	3·27	2·54	17·21	6·36	10·56	5·11	54·55	54·68
,, King's Bay ,, ...	2·49	6·46	2·60	3·83	4·80	18·30	7·72	10·05	5·24	61·49	60·58
,, Government Farm ...	1·18	2·59	·91	2·12	1·36	14·49	5·74	7·97	2·71	39·07	31·16
,, Old Grange	1·13	1·91	·79	4·76	2·01	16·71	5·81	9·21	4·19	46·52	*
,, Roxburgh	3·32	6·70	3·64	4·90	5·65	22·78	9·25	12·40	6·45	75·09	*
,, Friendship Estate	...	...	1·02	2·81	2·16	19·15	6·76	12·47	4·84	49·21	*
,, Lure Estate	...	...	...	3·00	5·24	23·07	9·44	13·22	7·05	61·02	*

* Stations from which no records were received previous to 1911.

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